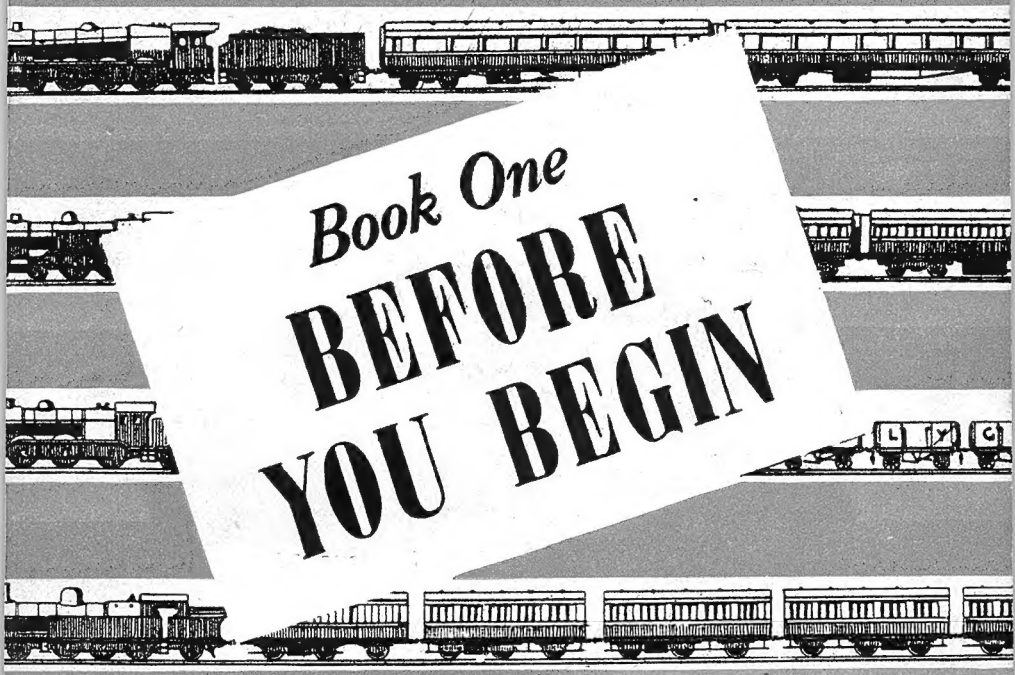
Edward Beal's

RAILWAY MODELLING SERIES



Book One

BEFORE YOU BEGIN

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EDWARD BEALS RAILWAY
MODELLING SERIES NO.1.

BEFORE YOU BEGIN

By EDWARD BEAL

Published by MODELCRAFT
77, GROSVENOR ROAD, LONDON, S.W.1.

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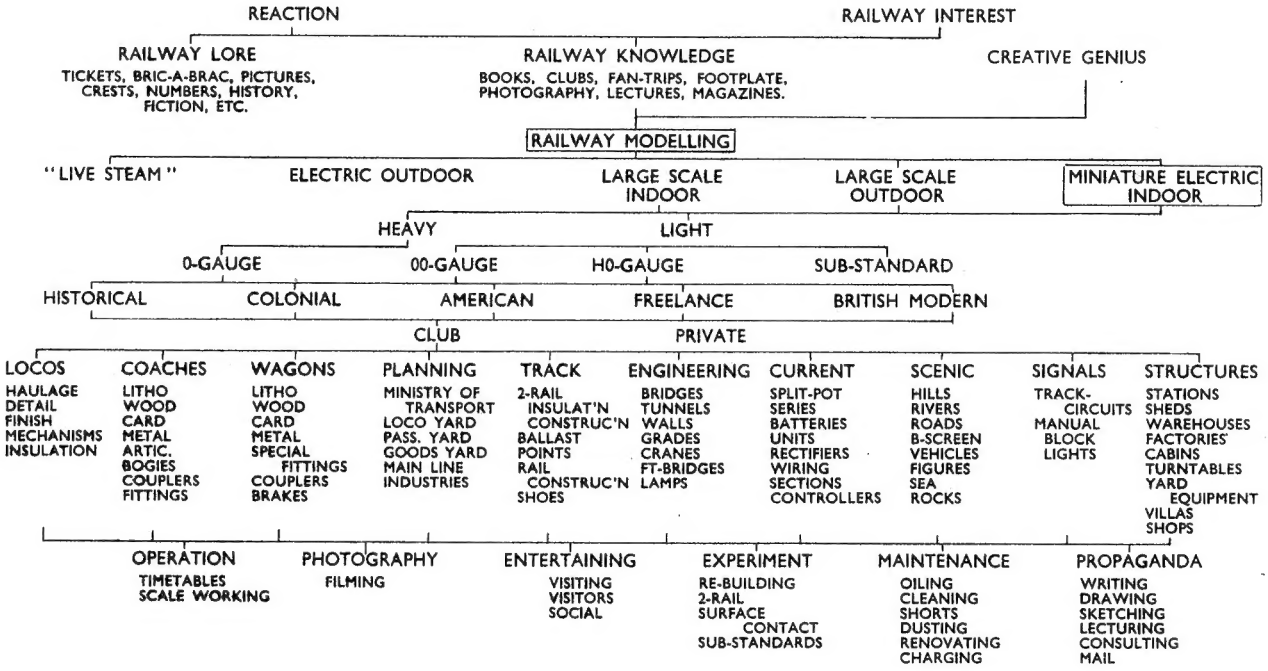
A "GENEALOGY" OF THE CRAFT



IDEAS BEHIND RAILWAY MODELLING

DURING THE PAST thirty years I have seen the craft of scale railway modelling develop from the somewhat dubiously held interest of a handful of devotees to the world-wide popular handicraft, numbering tens of thousands of enthusiasts, now so familiar to all who have any knowledge of the recreations of the public. It may, indeed, be the fact that international tumult and the awful deprivations arising out of two world wars would have much to do with its rise and growth. In order to be certain of this, of course, one would require to have observed its progress during a similar period devoid of these distractions, and to have marked whether under these more peaceful circumstances its growth would have been so phenomenal. As a close student of the psychology of the matter it has been impressed upon me that the craft does take its rise usually in some form of reaction from conditions. The cause of the reaction may be varied—a revolt from tedious business demands, or against an exacting mental or administrative vocation, or indeed against a variety of unfavourable compulsions from any quarter whatsoever. The chafing routine is there, and granting always that the affected person possesses a background of genuine interest in actual railways, the result is almost inevitable.

It is almost inevitable ; but not entirely so. A person impressed by the charm of actual railways may, when the reaction comes, turn to one of several alternatives. If you will consult the rather novel word-picture which I have drawn up as a sort of genealogy of the craft, you will see what I mean. The person under discussion may, for instance, when the reaction against external conditions becomes operative, fall back upon the fascination of railway lore, and may begin to collect railway bric-a-brac, tickets, pictures, photos, crests, or to read deeply into railway history. He may follow the attractive pursuit of noting locomotive numbers and the whereabouts of the units bearing them. Or, again and quite differently, he may probe more deeply into contemporary railway activity, mastering textbooks on railway and civil engineering, riding the footplate (if so fortunate), joining a railway club and going on fan-trips, attending railway lectures, witnessing railway films, contributing to railway magazines. I submit that, almost invariably, when the reaction comes to a railway enthusiast his line of procedure will be in one of these two directions. He will go right out after railway knowledge or railway lore.

But granted just something else, and assuming that he has gone in quest of railway knowledge, he will almost inevitably espouse railway modelling. And that " something else " is simply the possession of a strong creative genius. Let him be blessed or cursed with that faculty—and the deed is done. Out of his reading, study, observation and friendships there will spring an overwhelming instinct to make railway models.

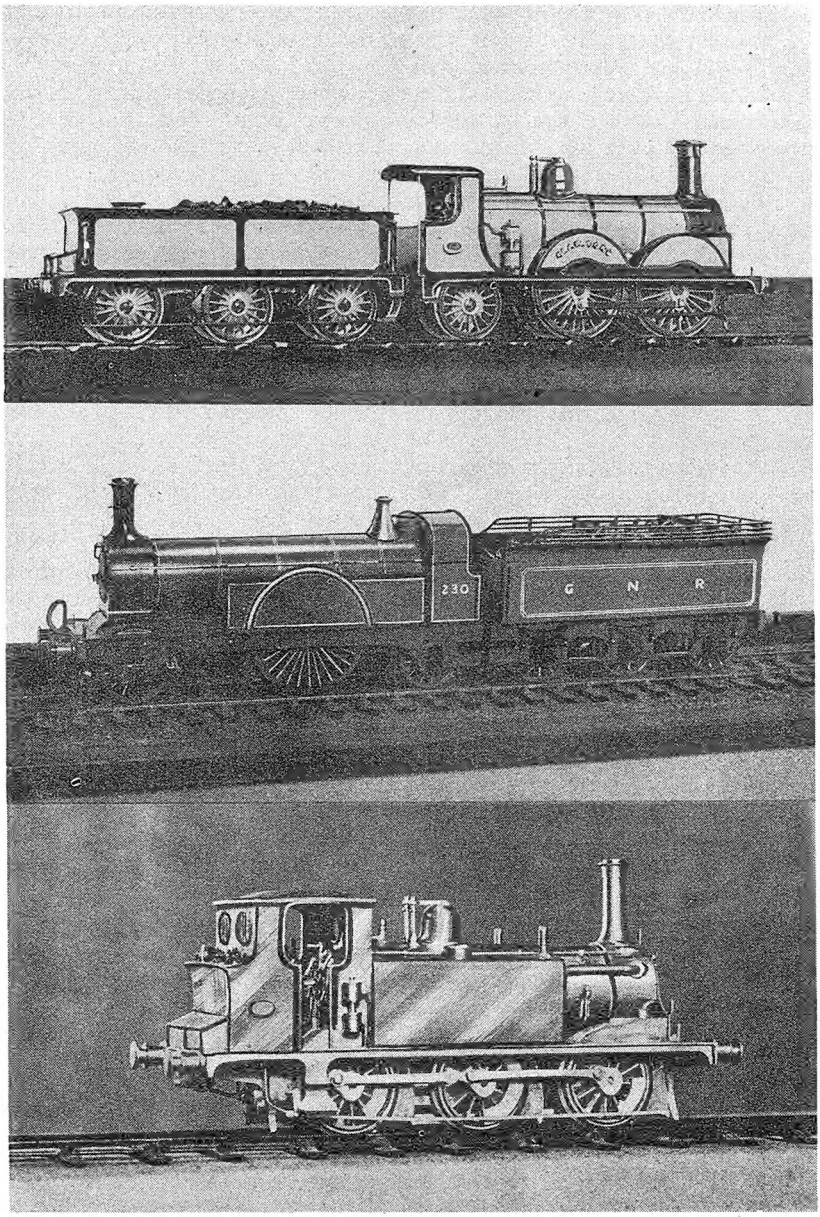
I do not suggest that this is invariably the manner in which recruits are enrolled. Frequently they enlist purely by infection caught from other enthusiasts, or from perusual of literature. But every time the craft has its spontaneous and genuine origin I think our genealogy is right.

What happens after the decision to embark upon such work has been made is, to use the phrase of our American friends, " something else again." Actually, the devotee may move in one of five directions. He may go in for " live steam " models, built purely for their own sake and operated on garden track. He may, still preferring the outdoor scene, take up the building of a miniature electric system in his garden, proceeding beyond the power and rolling stock stage to the wider realms of scenery, signalling, engineering and operating. He may, once more, despise the open air and start upon a large indoor line, but concentrating on locomotives, stock and simple working. Or he may fancy clockwork mechanisms for large scale units, though this phase is quickly becoming obsolete. Finally—and what mainly interests us here—he may decide upon the miniature scales and build an indoor electric system.

But do not imagine that the story is by any means fully told. It has hardly begun. Will he adopt heavy modelling, or light? If heavy, he will select 0-Gauge as his standard. If light, it will be a choice (by no means lightly determined) between 00-Gauge, HO-Gauge and one of the sub-standard gauges.

And here, having finally made his decision, he will find himself faced with some real and vital questions. Shall he design a layout on strictly historical lines, Colonial methods, American procedure, or of the modern British or the free-lance sort? Any one of these, and each a separate, integral interest, is open to his selection. And in any instance he must guard rigorously against foolish incongruities and sacrifice much to the choice he has made. No decent scale worker confuses in an amateurish manner any two of these ideas. If the layout be historical, locomotives will in every instance be early types, now probably extinct, and there will be no Pacifics, Mikadoes or Mastodons or Mallets. Nor will there be automobiles on his streets, colour-light signals by the tracks, or Pullman cars in his stations. If it be Colonial, while there may be a combination of certain characteristics common to British railways, there will be far more features that could not be included in a British type scheme. Similarly, if American, nothing will be included that is not American, even down to the scenic and structural details. For a generally free-lance layout there is a more catholic range of selection, including British and American types as well as Colonial and historical; but the standards of execution in free-lance work are just as exactingly faithful to true railway procedure. Whereas, for a modern British system, there must be nothing American, nothing ancient, nothing that is not meticulously what it claims to be.

Having then reached such a status, the unfortunate victim of this mania will probably have to decide once for all whether or not he will set out as a lone wolf, or join a railway modelling club, much depending upon his ability to secure a site for the layout he would like privately to own. Few workers have time or means available for both lines of activity. Leisure has its limitations, and life is short. If space is not available for



LOCOMOTIVES WILL IN EVERY INSTANCE BE EARLY TYPES
00-Gauge Models by W. C. Hardy, L.B.S.C., 0-4-2, G.N.R. Single, L.B.S.C. 0-6-0

personal use the enthusiast need not give up the ghost. By joining a club he can work just as happily, and maybe with greater social profit, than he could work alone. But he will have to decide definitely, I think, whether he will give his main interest to club life or to his own private work.

And now we have reached the stage where the truly amazing content of the branch we are dealing with becomes apparent. For whether it be in a club or within his own domain, there will be the alluring appeal of locomotives, rolling stock, engineering, planning, trackwork, current distribution, signalling, structures, etc. With locomotive work there come the problems of necessary hauling power, whether engines shall be modelled in their fullest detail or for the sake of their general appearance, what type of mechanisms to use, and, if two-rail power supply is adopted, what form of insulation shall be preferred. Coaches—how shall they be designed and built? Shall they be constructed from lithos or hand-finished, from wood or cardboard or metal? What details shall be included, and how shall they be coupled? When wagon building is undertaken similar questions will arise. Wagons may be built of plywood and have a super-detailed, hand-painted finish, or they may be cardboard with litho papers for a detailed surfacing. They may require to be of metal throughout; they may be common, everyday wagons, or wagons for special purposes. And they will require such fittings as axleguards, brakes, wheels, couplers, and so forth, all of which must be selected from a competitive range. When the planning of the line begins, there will be the rules of planning laid down by the Ministry of Transport, the precise requirements of locomotive yards, passenger coach tracks, goods yards, factory sidings and main lines. Closely associated with these problems are the vital matters pertaining to civil engineering in railway work—the correct designing of railway bridges, tunnels, gradients, culverts and retaining walls, as well as footbridges, cranes and lamps. Trackwork itself has for the modeller two great alternatives, one or other of which he must decide upon. Shall his tracks have two rails only, serving both for running trains and conducting power, or shall a third rail be added as part of the current medium? If the former, there will be important matters of insulation, construction and ballasting. If the latter, the same problems will take an entirely different form.

The current itself, and its sources, is yet another subject for investigation and decision. Will power be supplied from batteries, and, if so, will they be arranged in series, in parallel, or by the split-potential method? How shall such batteries be kept fully charged? The approved method is, of course, by means of rectifiers or transformers, depending upon whether the house mains are Alternating Current or Direct Current. But in view of the fact that the voltage even for 00-Gauge has now been standardised at 12 volts, and because the cost of batteries is in these days very high, it may be preferred to use a power unit, giving current direct from the mains at a reduced voltage, and in this event batteries will be dispensed with. The range of knowledge required for the complete wiring-up of a layout is extensive, though not particularly advanced; and the principles of track-sectionalisation will have to be mastered. A knowledge of controllers, switches, switchboard design, provision for automatic electric features and the details of point wiring is required.

This subject is closely allied also to that of signalling, which is itself an independent study. Shall the system chosen be manual or electric? Semaphore or colour-lights? Where shall signals be placed in absolute fidelity to real practice, and how shall they be made? Shall the signals be arranged to control the trains, or shall trains control the signals? Shall the semaphores be operated electrically by the same movements as those by which current is supplied to locomotives, or shall they be independently worked by hand levers? What eliminations and modifications of signalling are necessary and permissible within the restrictions of model practice?

The wide realm of railway structures also demands some degree of intelligent and even expert knowledge. Most layouts are spoilt by the unrealism and incorrectness of their buildings. Shall stations follow Victorian or modernistic design in architecture? What kind of freight sheds will be most effective and correct at certain localities? What capacity and type of engine sheds are required? Coal mines, factories, signal cabins, turntables, yard equipment and even shops and villas also come under this head. For the proper designing of any of these it is wise to consult authoritative textbooks, or to make close observations from existing examples.

Finally, there is the scenic setting of the entire layout, upon which so much depends. As will be generally known, the work of landscape modelling is an artistic handicraft in itself, with its own literature and standards. The provision of a scenic backscreen, the formation of the terrain through which the tracks will pass, the creation of miniature hills, mountains and valleys; the introduction of judicious glimpses of rivers, roads, rocks and the sea, and the inclusion of suitable and convincing pedestrian and vehicular road and station figures—what a world of interest is here to be discovered!

The question has often been asked, "What function does a miniature system serve when it is, for all intents and purposes, completed?" And here, again, the answer is capable of almost as many sub-divisions as is the work of construction itself. Whether it be under the ownership of a club or a private individual, the constructed layout offers varied aspects of enjoyment. First, there is operation itself, with the formation of working time-tables designed upon true operating principles. There is the work of photography, in which numerous modellers excel, and for which the competitive quality of success runs very high. There is a new and almost untouched art in the filming of operative layouts. Again, a large part of the pleasure of operating is for the benefits of entertainment, whether given or received. Enthusiasts visit one another for their mutual help and inspiration, or receive their friends with a novel form of welcome. Much of the delight arising out of a completed system is also to be found in the task of maintenance—oiling, cleaning, dusting, electrical adjustments, renovating, and the care of power units. Beyond this, for the more expert, there is the ever-continuous work of experiment and research, since many phases of the handicraft are still in their early stages of perfection and await the ingenuity of the skilled craftsman. The fascinating processes of rebuilding, the mysteries and possibilities of two-rail power, the marvels of the sub-standard scales, and such matters as the surface-contact system

" THERE IS THE SCENIC SETTING OF THE ENTIRE LAYOUT."
Station yards and their scenic environs by Mr. Theo. Pearson and Mr. J. K. Nelson.

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of power supply—all these await the zeal of the master. Finally, there is the pleasant vocation of propaganda, with writing, drawing, sketching, correspondence, lecturing and consulting as its accepted media; and this in itself links up its followers in an ever-expanding social fellowship.

Let it not be thought that in endeavouring in this manner to detail the craft and its offshoots I have aimed to discourage the amateur on the threshold. My purpose has merely been to indicate for the benefit of onlookers where the charm of railway modelling actually resides, and to indicate that its devotees are really after something interesting, valuable and in the highest sense remunerative.

RELEVANT FACTS AND FIGURES

WHILE WE ARE still on the theoretical side of our subject, it might be as well to give the inquirer some idea of the extent to which the craft has developed and of its numerical following. I have frequently been asked by reputed publishers and magazine proprietors for my opinions on this question, and the inquiry does not lend itself to an easy retort. There is one leading magazine devoted to the craft in America which has a circulating list of sixteen thousand, and which provides no other matter for " alien " readers. In the same country there are several other well-produced journals partially or entirely devoted to the subject. In Britain the figures are smaller, though I doubt whether they are far behind. The books of one writer, exclusively railway modelling in their scope, have sold over thirty thousand in Britain. This does not signify, of course, that each book-sale represents a separate recruit—far from it. But it possibly warrants our placing the British figure at a definite ten thousand ; and this provides, with possibly numerous adherents in Australia, New Zealand, Africa, and the Continent, a round figure for the world amounting to something like thirty thousand. I would consider that to be a moderate and careful estimate.

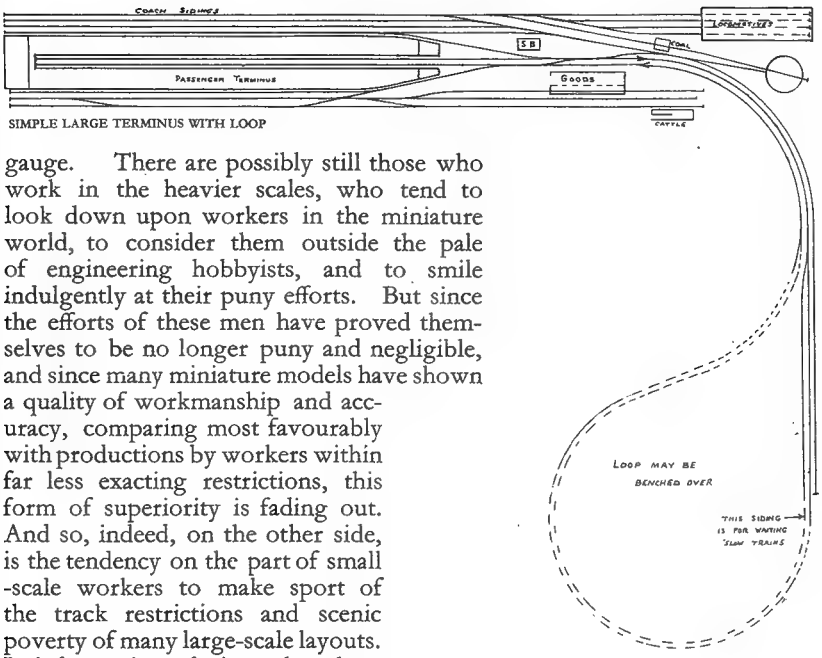
It is possible, to a far more definite degree, to give considerable authentic light on other vital statistics. Every year, the " Model Railroader," a superbly produced journal circulating in America, produces the results of a questionnaire mailed to each of its readers, and to which an amazing number of enthusiasts respond. The findings of this questionnaire for 1946 were most interesting, and there is little reason to suppose that they vary from the response which a similar investigation in this and other countries would produce. According to its findings, the average railway modeller is 34 years of age, has attended a secondary school, and is, in about a fifty-fifty proportion, a university graduate. His income amounts to what in this country would be about seven pourds a week. Three-quarters of the whole are married men, and the average amount spent by each craftsman is about equal to twenty-five pounds a year in Britain. Almost half the railway modelling public have been engaged in this work for over five years. Almost half are devoted to the equivalent of our British 00-Gauge, and one-third to 0-Gauge.

From this analysis, I think, the beginner in this country may form some sound notion as to the magnitude and range of the hobby.

ONE MAN PREFERS A MINIATURE COUNTRYSIDE.
A scene on the 00-Gauge layout of Mr. John Ahern.

THE CRAFTS WITHIN THE CRAFT

THE BROTHERHOOD of railway modellers is a wide one, in which a great measure of friendly toleration is required. During the early stages of the growth of the cult there was much antagonism, not always of an entirely friendly nature, between the advocates of this or that scale or



SIMPLE LARGE TERMINUS WITH LOOP

gauge. There are possibly still those who work in the heavier scales, who tend to look down upon workers in the miniature world, to consider them outside the pale of engineering hobbyists, and to smile indulgently at their puny efforts. But since the efforts of these men have proved themselves to be no longer puny and negligible, and since many miniature models have shown a quality of workmanship and accuracy, comparing most favourably with productions by workers within far less exacting restrictions, this form of superiority is fading out. And so, indeed, on the other side, is the tendency on the part of small-scale workers to make sport of the track restrictions and scenic poverty of many large-scale layouts. It is becoming obvious that there are many crafts within the craft itself. It is definitely and increasingly true that the 0-Gauge and the 00-Gauge workers are each following distinctive interests, and that these interests are in fact so distinctive and separate that many an 00-Gauge worker would abandon the job entirely if he were forced to adopt 0-Gauge. It is perfectly true that 0-Gauge models leave many a worker in the small scales cold, and that 00-Gauge models have almost no appeal to many an 0-Gauge fan. But it remains true also that all railway modellers have an enormous lot in common, and much to stand for and to defend together.

So long as there is such an interest, there will be one man who likes to have a miniature countryside in which to plan and construct a layout, another who is quite content with a terminus station and a loop on which to dispatch and receive traffic, another who prefers to work on heavier jobs that he can feel the weight of. There will be others still who have little interest in anything beyond locomotives and rolling stock, and the production of these in perfection of accuracy, or who are actually unable to provide anything in the way of a site at all. And there will be others whose genius lies in the direction of experiment, and who will want to work in lonelier spheres like that of 2-mm. scale modelling. It should be remembered that the form of a man's work is his own free choice, and that the craft is absurd if it provides heated controversy in place of pleasure.

The only serious interloper in the entire field, against whose machina-

tions everyone ought to be opposed, is the infantile designer who imagines railway modelling to be a child's game, and who writes books and articles revealing little else than his own total failure to appreciate the dignity of the work. There is also the armchair critic, who produces nothing, but who finds endless fault with those who are more industrious, and whose zeal rapidly fades out for want of manual expression. One of the first things to lay to heart is that interest, like expert knowledge, only grows with manual application; and a proof of this is found in the fact that when there comes even a temporary halt in manual application the general interest flags. But conversely, that interest revives as soon as a fresh start is made.

Let us, however, pass from this comparatively theoretical introduction in order to look at some really practical questions which the beginner must face before he begins.

SCALE AND GAUGE

THE PROBLEM of which scale to work in is definitely related, of course, to the kind of site at one's disposal and to the amount of money one can afford to devote to the work. But there is more in it than that; these are only two influencing factors. The real determinant of scale is the question as to what the *desired content* of the layout is. Granted that you have a space at your permanent disposal which is large enough to house a scanty 0-Gauge system, or a much fuller system in a smaller scale, then you will have to decide whether you want a large-scale skeleton layout, or a layout in the same compass embracing a lot more track and detail. The point I am making here is that it does not follow that 00-Gauge and HO-Gauge are solely for small spaces and for table-tops. It is a perennial surprise to me that more clubs do not adopt the smaller gauges when they have almost unlimited layout area at their disposal. Here, where you have the joint services of a dozen engineers and operators and maintenance squads, is the chance to lay down a *real* railway system in miniature, demanding exactly the same amount of engineering genius for power and stock, but also providing a far more extensive field for the application of signalling science, trackwork, traffic manipulation and electrical control. Where it is an individual enthusiast who is to be the builder and owner, of course, the matter is different; and it is quite possible to design a large layout which will be so vast as to defy the capacities of one worker to maintain it. But with a society there is no such danger.

But the same question as to desired content also applies within limits to the individual worker. I have found in the instance of the West Midland Lines that an involved system occuping a space of 21 ft. by 14 ft. is by no means exacting in its demands on maintenance and attention; and it certainly does allow me to have a layout which deserves the name. Within the same restrictions I could have installed a quite workable 0-Gauge scheme, but consider what I would have missed! Two stations of a very modest design would have swallowed up the whole area now occupied by

five ; the main line run, instead of being 200 ft., would have been cut down to about 50 ft.; the stations would have been far less accessible ; there would have been no scope for scenic architecture ; bridges would have been short and disproportionate. Curves would also have been prohibitively sharp ; a respectable train would have occupied the entire length of the room. It is true, no doubt, that I am by nature a small-scale fan, though I am anxious to do the utmost justice to 0-Gauge ; but I maintain that there is a vast field of 00-Gauge operating possibility that has not yet been explored. And the reason for this is the " little space, little gauge ; big space, big gauge " illusion.

During the war period, an opportunity was found for establishing the British Railway Modelling Standards Bureau, and this Bureau has laid down fixed dimensions which were long overdue, covering the requirements of all the gauges. One of its new departures was the formation of a new 00-Gauge scale standard entitled the " scale 00-Gauge." This has for its track-gauge 18 mm. in place of the former 16.5 mm., and is in many aspects more faithful to British railway profile. During the recent conversion of the West Midland to two-rail power supply, I had to face definitely the problem of " standard " versus " scale " 00-Gauge myself. There were several very important determinants which influenced me to remain " standard," few of which have been dwelt upon for a moment by advocates of the " scale." The most important of these was that of curve radius. A 2-ft. radius curve in the 16.5-mm. gauge gives no trouble whatever to heavy six-coupled passenger locomotives ; but I am quite sure that in 18-mm. gauge the same engines would entirely decline to keep the rails. Furthermore, the new scale track would not coincide with any one of the American track-gauges, being unique in itself ; and I wanted to take advantage of the marvellous range of American HO-Gauge engines, which work admirably within our 4-mm. scale British standard loading gauge. Still further, the perfected British model 00-Gauge mechanism has still to come on the market, while there has been for a long time the choice of quite a range of American mechanisms to this gauge. And finally, I am not so desperately impressed with the front-end advantages which are no doubt gained by the adoption of the " scale " dimensions. That these advantages exist I do not dispute, but they are only obvious to the initiated expert, and then only from one rarely-chosen angle ; and the fineness of the wheel dimensions thus afforded appear to me to promise further trouble in the matter of track clearances, concerning which it is only recently that satisfaction has been achieved with the slightly heavier " standard " dimensions. Added to these considerations is the fact that the commercial field in the " scale " realm is much more restricted, and probably will be, than that of the " standard."

But these questions are all personal, and it is for the beginner to take into view all the conditions and then choose his own course. If he has plenty of space indoors or out of doors, and if his inclination is towards heavier modelling, let him adopt 0-Gauge. If he prefers light modelling and the maximum of comprehensiveness in planning, no matter what his space may be, let him choose one of the smaller scales.

CONSTRUCTION OR PURCHASE ?

HERE IS ANOTHER practical issue. Shall the enthusiast take advantage of the commercial market for certain components, even when they might quite well be made by hand, or shall he " make everything himself " ? To be sure, there are some items which cannot be made by hand, such as rail and chairs, wheels (where there is no lathe), and so forth. But the question of purchasing and collecting commercial models readily passes from the expediency of buying items which one cannot construct to the wider question of buying completed locomotives (let us say) in order to save time, and utilising the time thus saved by applying it to other forms of manual construction.

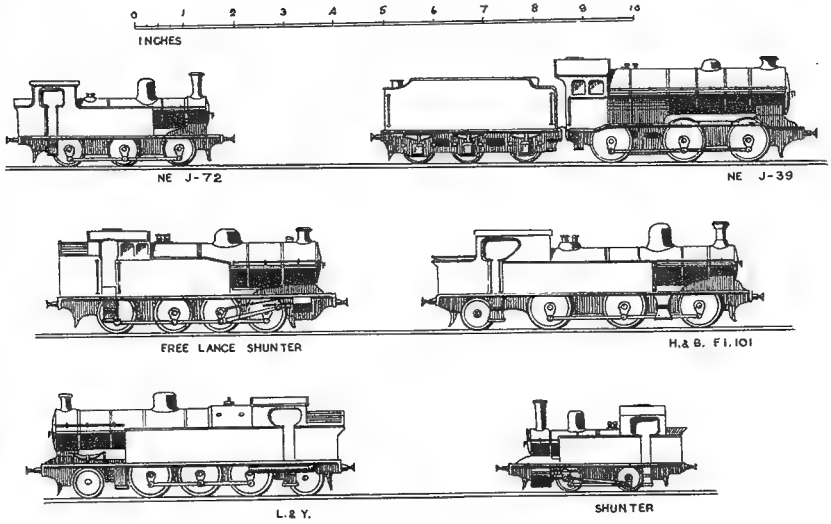
I have met large numbers of workers who look upon this subject as a sort of moral issue. They " don't believe " in buying anything, because they have a conviction that to do so is to violate the whole idea of the craft. Usually, because they are purists, they never get their layout into operation owing to the sheer brevity of life and the inexorable march of time.

Surely it ought to be clearly understood that there is no reproach in the mere collecting of models if the collector can afford it, nor in his taking a personal pride in his collection, and in the artists he selected to do his work. For myself, I would never dream of building coaches. I do not possess the machine tools or the mechanical skill for the work, and I can buy them better than I could make them in twenty years. I can also buy them designed and built to my exact requirements, which are the result of thirty years experience. But neither would I dream of buying freight stock, for the simple reason that I can do the work better than most professionals. It is again a matter of individual skill against scarcity of leisure. You can take it from me that if you build locomotives and rolling stock, freight and passenger, you will probably have to buy everything else if you want to get down to operation before you are eighty ; and if you build your own track and structures you will have little time to build rolling stock and engines. And if by any chance you succeed in universal building, it will only be because you use as many commercial components for your stock and track as you can possibly buy.

DECISIONS BEARING ON CONSTRUCTION

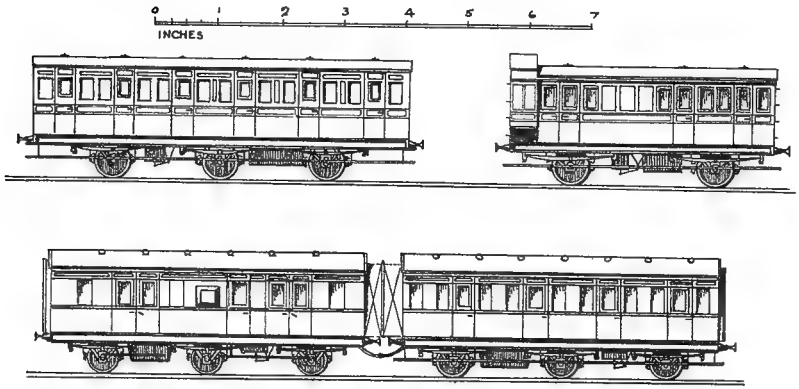
I HAVE ALREADY touched upon several subjects which call for a decision in the earliest stages of procedure, and need not enlarge upon them again. Whether the scheme is to follow a modern British main line of railway, or whether it is to be a model of a light railway is an outcrop of those early questions. Accepting the assumption that you are to go in exclusively for British prototypes, is it to be a light or a standard line—a

line like the L.M.S., or something akin to the Isle of Wight railways? If you select some definite prototype, it will be essential to adhere to the form you have adopted. A section of standard main line will involve at least one reasonably large station, though—let it be here inserted—not *too* large. If it is a main line, again, you will require turntables at divisional and terminal points of adequate size to accommodate main-line tender engines. You will have a free range of choice regarding large-capacity and small-capacity equipment, such as coaling and watering appliances, depending upon the size of the station equipped. You will probably be working on the whole with double track, double junctions and so on. Your station platforms will require to handle trains consisting of a standard large engine and four to six bogie coaches. Your station sites will therefore need to be fully 12 ft. long for 00-Gauge, if not longer. For, unless you are to foul your main lines with shunting, you need within your station limits a length covering double the length of your longest train, plus about 2 ft. for crossovers. If you intend to run longer trains, as well you might, you will require sites correspondingly longer. Remember, that we are not indulging in play; we are modelling.



POSSIBLE LOCOMOTIVE TYPES
FOR A BRANCH-LINE LAYOUT

But assuming that you will be content to run tank engines, and may be six-wheel coaches, confining yourself to light railway practice, you can do much better in a restricted space. You will then need no turntables, the lightest type of coaling appliances, much shorter platforms and correspondingly shorter stations. Nor is there any real disadvantage in modelling light railways in place of standard lines. Small locomotive



NON-BOGIE COACHES ARE NOT EXCLUSIVELY HISTORICAL RELICS.

types are just as attractive as large ones, and within modelling restrictions they can give just as great efficiency. Even six-wheel coaches are not exclusively historical relics ; there are examples in real service introduced as recently as 1933. And there are very numerous four-wheel vehicles which are still used in express freight traffic along with passenger trains.

The advantage of a main-line layout, of course, is that you can use both varieties of stock and all forms of power. It is a matter for your personal decision, to be adhered to when once formed.

On the whole, then, we may thus enumerate the advantages of " main line " and " light railway " practice in modelling :—

Advantages of Main Line :

All types of locomotives can be used ;
Full length passenger coaches permissible ;
Slightly longer trains owing to heavier locomotives ;
All types of rolling stock.

Advantages of Light Railways :

Sharper curves and longer straights ;
Less gradient trouble with lighter trains ;
No turntables required ; less station area ;
Shorter platforms possible ;
Larger number of stations in same space ;
More convenience in modelling small units ;
Cheaper cost.

Will your system be a model of a real railway at all ? Or will it be purely imaginary, merely abiding by the rigid standards of actual practice in a general way ? That is to say, it may be confined to British procedure, but possess no actual prototype. You may adopt the initials L.N.E.R. on your locomotives, but they may represent, for instance, the Lancashire, Norbury & Exmouth Railway. That is a rather good expedient, for it allows you to use London & North Eastern colours for your units, whereby on some occasion it will be easier for you to sell or exchange them. At

the same time it allows scope for stock which the actual L.N.E.R. never did possess. This is a form of free-lance working, with its licence not extending beyond British procedure.

Or you may go all out for free-lance work, acknowledging no country's exclusive standards whatever. Yet you will be strictly bound, if you are really modelling, by the universal laws of designing and the basic principles of civil engineering. Under this scheme, you can run American Mallets alongside early North London tank engines; and you can instal a British type stone arch occupation bridge within easy reach of an American timber trestle. I may as well admit that this is the form of scale work which I myself have always preferred and followed, for I like to have at the touch of my controllers anything I fancy that is correct. I would not for a moment sacrifice the pleasure of a vast field of otherwise excluded features. Here, then, is another choice of alternatives, with their respective advantages :—

Actual Prototype :

Added interest of fidelity to specialised field ;
Opportunity of using specialised knowledge ;
Conciseness or narrowing down of research.

Free-lance :

All types of locomotives from any country ;
All forms of rolling stock within self-imposed limits ;
All manner of brdges : British, American, etc.;
Any form of efficient coupling ;
Buffers or no buffers as standard ;
Standardising favourite examples of any company : cabs, signals ;
Any form of scale track, including flat-bottomed rail ;
Round houses or rectangular ;
Cosmopolitan selection in architecture ;
Optional use of modern and ancient models.

You may decide upon an exclusively electric type of railway, on which there are no allegedly " steam " trains ; and you may even provide for this by installing an overhead cable or catenary power supply. There are many such systems in this country, and America abounds with them. Here, the range of meticulous and meritorious modelling is by no means restricted. Your " inter-urban " trains must be just as faithfully true to real practice as your steam trains would have been, and an entirely novel type of station building presents itself for simulation. There is a lot to be said for this idea where space is at a premium, for platforms can be very short and curves very sharp.

Again, is your layout to represent one company, real or fanciful, or is it to be a network of two or three integral companies ? You might have a Northern Company and, say, a Western, planning competitive routes to identical destinations, or having running rights over mutually-owned sections of road, or providing transferred or through trains to extreme points. You might design an American trans-continental system, embracing a Pennsylvania, a Union Pacific and a Southern Pacific, or a New York Central, a Rock Island, a Santa Fe and a Denver & Rio Grande. I recollect

once whiling away weeks of invalidism in designing countless layouts of this order. Each company had its own locomotive headquarters and servicing depots, and there were individually owned as well as union stations.

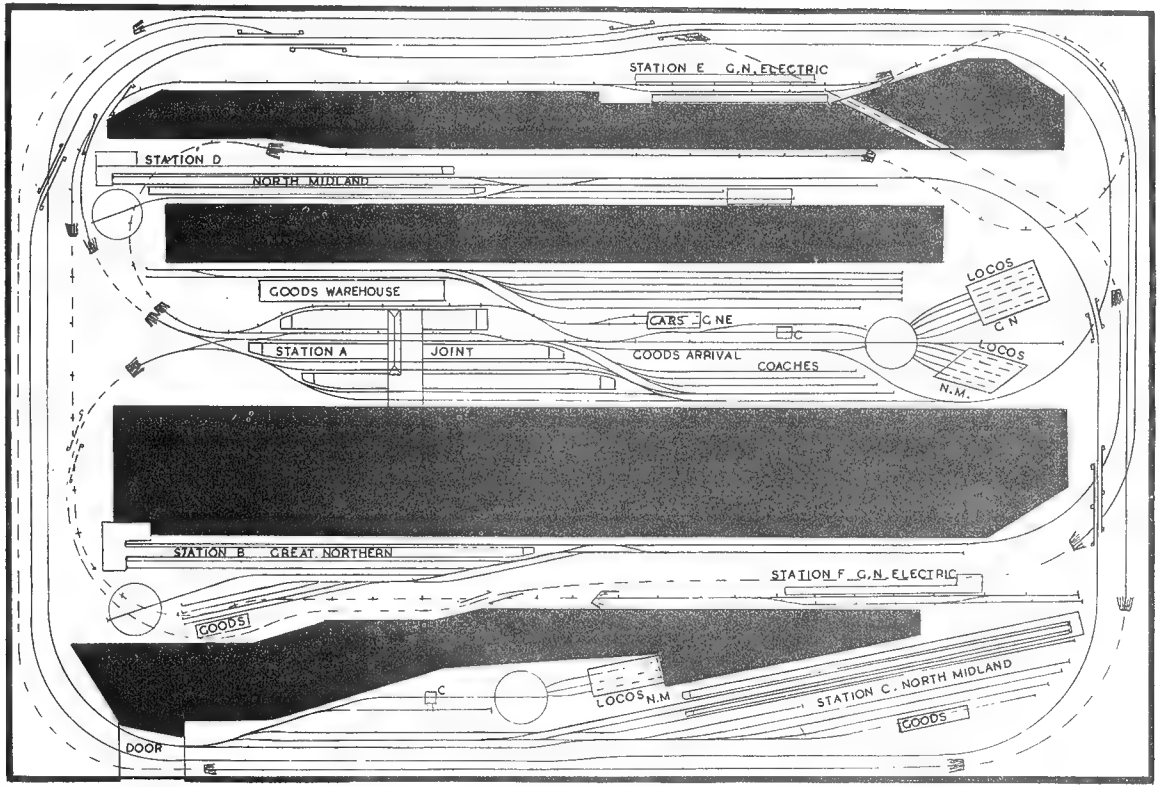
As an example of what might be accomplished in this manner, I have included a diagram of a possible club layout, incorporating three companies in one system. The plan must be understood as merely in outline—the scenic details are left to the imagination of the reader. The space required for the scheme in 00-Gauge would be 24 ft. by 16 ft. The leading idea is that of a large central union or joint station, with various single-line routes leading out in all directions. I have given the respective companies the titles Great Northern, North Midland and Great Northern Electric. It will be seen that the main line runs are considerable in length and are sufficiently varied and contrasted in their interest. Starting from station C (North Midland) in the extreme lower right-hand corner, the journey—the shortest of the three—is almost completely around the four walls to the station A in the centre. This station being a " through " one, the route may be continued or may cease. If it is continued, it will be by way of the tracks to the left of the station. The North Midland line is the one leading downwards. If this is followed, an extensive run of twice the size of the room is taken as far as station D (top left). But besides this integrally-owned route, there are two others leading out to the left of station A. Both turn northwards. One of them takes two laps around the room to station B (Great Northern) ; the other is an all-electric train railway on which single-car or multiple-unit electric trains are run. It is shown by the hatched track. Its curves are sharp, since all traffic will be bogie coaches, and its run extends across and down to the bottom-left. There are two stations *en route*, both of which are small, the line being of the suburban type. At station A there are joint facilities for all three companies.

The interesting feature of such a scheme is that through coaches may be run from one extremity of the system to the other, the journey from station B to station D being a very extensive one.

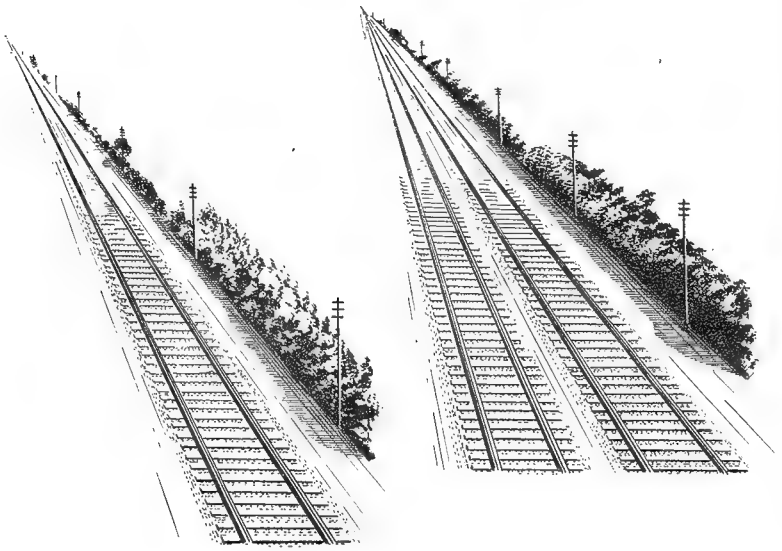
Once more, as to track planning itself, what are the merits and demerits of single and double track ? Double tracking has attractions of its own from the standpoint of running and operation. With double track you may run up and down trains simultaneously if you wish. Apart from this, you can run more trains at a time. And double track has a sound, businesslike look about it. It can be made to appear most effective when viewed " by the length " on the layout. It also obviously makes for convenience of operation, as for instance at a reverse loop. Much will depend upon what you are modelling ; if it is an actual line you are copying then the question of single- or double-track will depend upon the prototype. But there is also much in favour of single-track. Given a limited amount of rail to use, you can get a longer point-to-point run by arranging it singly. You will entirely eliminate double junctions, with their occasionally problematic crossings. You will use fewer points, for you will not need so many crossovers. Another striking feature in favour of single-track is that a length of it looks longer than the same length of double, just as a

DIAGRAM OF CLUB MULTIPLE LAYOUT

Scale $\frac{1}{4}'' = 1ft.$

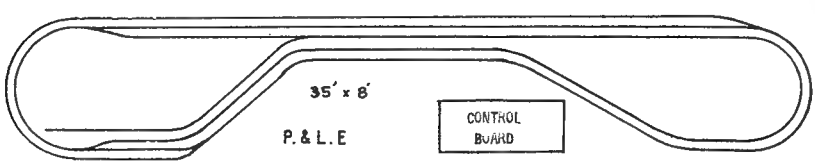


drawing board looks shorter than a walking stick, the one being broad and the other narrow. Nor is there any sort of stigma attaching to single track, since all the railways have miles of it, and most of the great trans-continental routes run their heaviest and fastest trains on a single-road route. You can keep it just as perfectly maintained as double track.

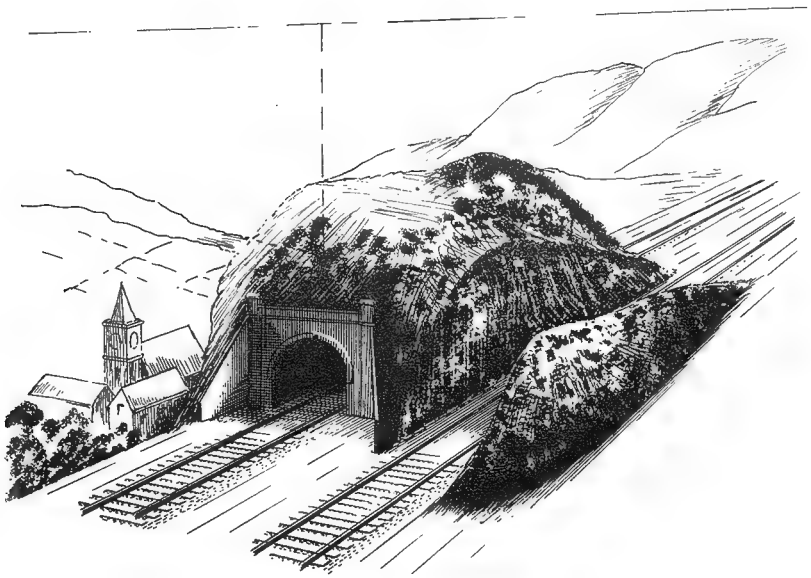


A STRIKING FEATURE OF SINGLE-TRACK—LOOKS LONGER THAN THE SAME LENGTH OF DOUBLE-TRACK.

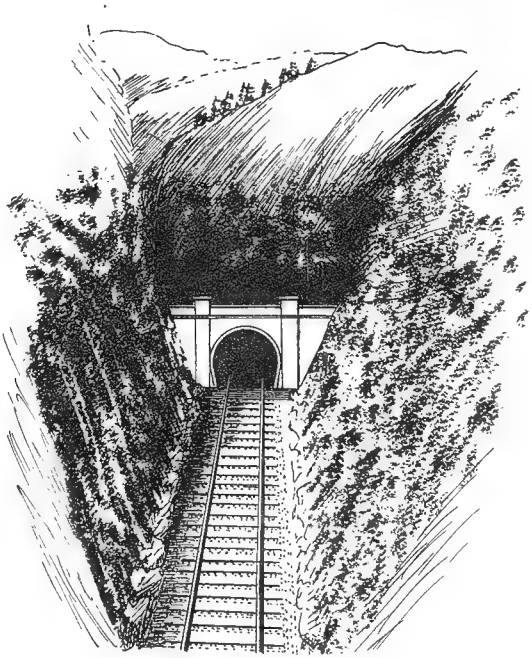
Once more, it is largely a matter of taste. As for double-track, much may also, of course, be adduced on its behalf, and indeed on behalf of triple- or quadruple-track. Occasionally, in a restricted space, it is impossible to secure a repetition of run without recourse to the laying of the tracks side by side. But this is hardly the same problem as the choice between single- and double-track laying. Single tracks may sometimes line up with each other to look like double tracks, while they are actually single roads going to different places and serving distinctive purposes. A diagram makes this clear.



A weightier matter is the choice between two-rail and three-rail power supply to locomotives. I have said a lot upon this theme elsewhere, and the subject really deserves a handbook to itself. Yet it is one of the issues to be faced and settled before construction begins. In favour of the earlier three-rail method of supply, there are no advantages beyond that of the fact that it is a possible way of running a system with a tolerable measure of reliability. It is, however, unsightly both as regards track and locomotives, and lends itself to numerous petty irritations arising from maladjustment. The advantages rightly claimed for two-rail are that it dispenses with unlovely collecting bars and the incongruous outer rail, that it gives better contact for current collection, that the track is far easier to clean, that it allows for self-sectionalising of sidings and yards, that there is much less likelihood of short circuits, and that electric coaches, as such, may be run without ambiguity and without the use of a third rail. For the new beginner, the true attitude in which to face this question probably is to discard the entire notion of three-rail as an out-of-date and interloping idea, conceived in early years as presenting fewer problems for experimentation and leading to a quicker result. Two-rail is the correct way, even if its difficulties were enormous ; but these difficulties when compared with its competitor in *its* infancy are purely imaginary. There are people who are already committed to three-rail on a considerable scale and who, therefore, have little, if any, knowledge of the two-rail system. To these



CONCEALING A BREAK IN BACKSCREEN CONTINUITY.



A CUTTING THAT WOULD OTHERWISE BE TOO DEEP.

it is a great temptation to dwell on the imagined hardships of the new and the simplicity of the old. Were I myself a starter, I would not waste two minutes upon the subject. I would line up with the correct method and think no more about it.

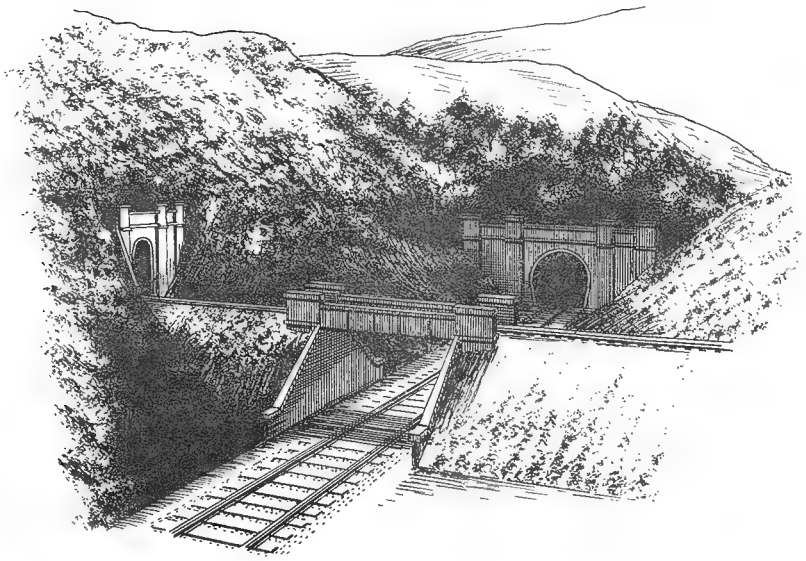
The majority of beginners act upon the assumption that a number of tunnels must be included in a layout, and occasionally they are deliberately placed over a length of main line merely for appearance. The inclusion of tunnels has an important bearing on construction, and should be well thought out before any track designing is started. It should be remembered that unless they are so built and placed that access can immediately be had to the tracks, they are nothing but a nuisance. This remark applies to all kinds of covered and concealed tracks, whether the tunnel be of the scenic kind, or the tracks merely run beneath a baseboard forming a higher level above. Some of the sanctioned reasons for the placing of tunnels may thus be tabulated :—

Constructional purposes :

Running tracks beneath a baseboard to form unsightly reverse loops ;
Passing tracks below high-level obstacles not otherwise avoidable ;
Beneath baseboards or elsewhere to house hidden waiting loops.

Scenic purposes :

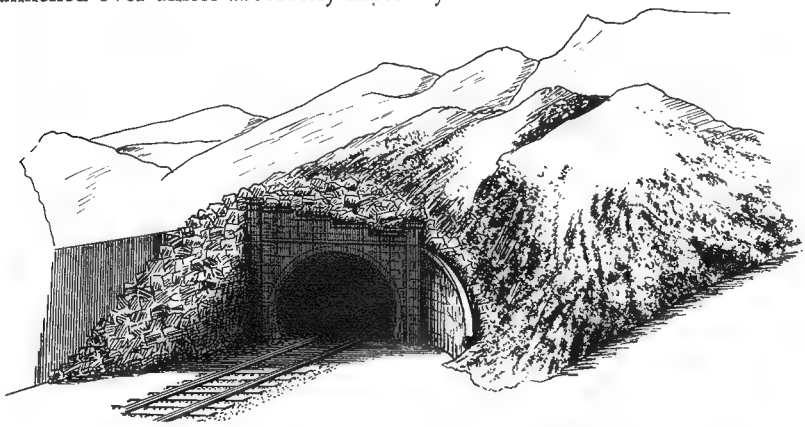
Concealing the whole of a corner that would be unsightly ;
Concealing a very sharp, but yet negotiable curve ;



AN UNSIGHTLY REVERSE LOOP OR SPIRAL.

Joining a bad break in backscreen continuity ;
Concealing an over-obvious link track forming a continuous run ;
Bringing down a backscreen hill to cover a gap below the hill ;
Forming part of a cutting that would otherwise be too deep.

In other words, there should be some genuine reason for the inclusion of these troublesome features ; and where they are used at all there should be full freedom of access to the rails. Points should never be tunnelled over unless absolutely necessary.



A GAP AT THE BASE OF A BACKSCREEN.

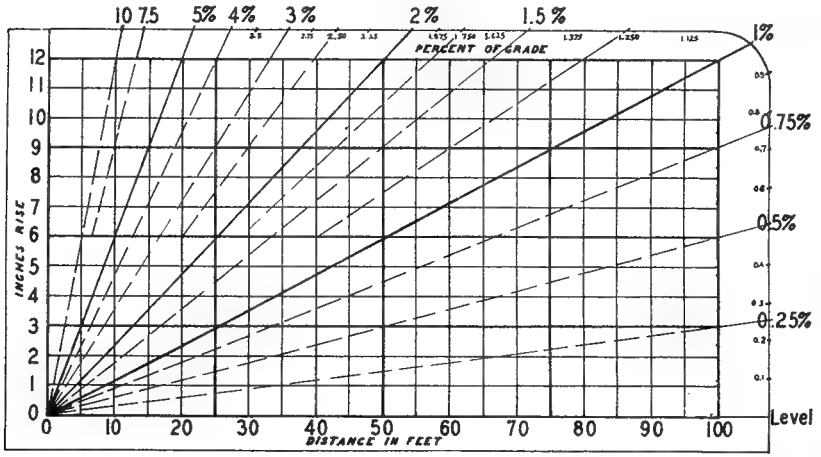
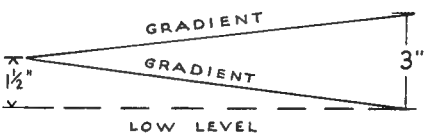


TABLE OF GRADIENT PERCENTAGES.

PLAIN RISE OR FALL

HALF RISE, HALF FALL



(NOTE. A convenient height for high level formation above low level formation in 00-Gauge is 3-in., comprising 2½-in. clearance plus ¼-in. for baseboard thickness.)

3-in.	rise in	3-ft.	equals	1	in	12	1½-in.	rise with	1½-in.	fall in	18-in.	equals	1	in	12
,,		4-ft.	,,	1	in	16	,,	,,	2-ft.	,,		1	in	16
,,		5-ft.	,,	1	in	20	,,	,,	2-ft. 6-in.	,,		1	in	20
,,		6-ft.	,,	1	in	24	,,	,,	3-ft.	,,		1	in	24
,,		7-ft.	,,	1	in	28	,,	,,	3-ft. 6-in.	,,		1	in	28
,,		8-ft.	,,	1	in	32	,,	,,	4-ft.	,,		1	in	32
,,		9-ft.	,,	1	in	36	,,	,,	4-ft. 6-in.	,,		1	in	36
,,		10-ft.	,,	1	in	40	,,	,,	5-ft.	,,		1	in	40
,,		11-ft.	,,	1	in	44	,,	,,	5-ft. 6-in.	,,		1	in	44
,,		12-ft.	,,	1	in	48	,,	,,	6-ft.	,,		1	in	48
,,		13-ft.	,,	1	in	52	,,	,,	6-ft. 6-in.	,,		1	in	52
,,		14-ft.	,,	1	in	56	,,	,,	7-ft.	,,		1	in	56
,,		15-ft.	,,	1	in	60	,,	,,	7-ft. 6-in.	,,		1	in	60
,,		16-ft.	,,	1	in	64	,,	,,	8-ft.	,,		1	in	64
,,		17-ft.	,,	1	in	68	,,	,,	8-ft. 6-in.	,,		1	in	68
,,		18-ft.	,,	1	in	72	,,	,,	9-ft.	,,		1	in	72
,,		19-ft.	,,	1	in	76	,,	,,	9-ft. 6-in.	,,		1	in	76
,,		20-ft.	,,	1	in	82	,,	,,	10-ft.	,,		1	in	82

TABLE OF GRADIENT RATIOS FOR 00-GAUGE.

I have left until last the important subject of gradients. Do not begin your designing until you have worked out thoroughly the *pros* and *cons* attaching to these. It still remains true, remember, that the ideal layout is one without gradients of any kind, precisely as in real practice gradients are something to be avoided. An all-level track design would not only be far less troublesome to operate ; it would prolong the life of motors and mechanisms fully four-fold. The recent conversion of the standard voltage for the smaller scales to 12 volts in place of 6 volts will, no doubt, make for much greater ease in the working of trains over gradients ; yet the danger of gradients to the life of mechanisms will still, in great measure, remain.

Having said all this, however, if gradients are kept lenient in their ratio, there is much to be said in favour of them. Without doubt, a layout having two or more levels is much more interesting and lends itself to wider scope in engineering construction than one without gradients. It must be borne in mind that wherever one track passes above another there has been a gradient involved, and most bridges of the shorter and more picturesque kind are for the purpose of thus carrying the tracks. Without a gradient there can be no such thing as a flying- or a burrowing-junction, and these are extremely attractive features on a layout. Further, no designer can work on a track diagram for ten minutes without discovering that for an average-sized room an all-level scheme is practically ruled out. For the most part, tracks must inevitably pass under one another when laid within four walls, if there is to be any considerable length of main line. It, therefore, becomes a question of keeping strictly within lenient percentages for the gradients constructed.

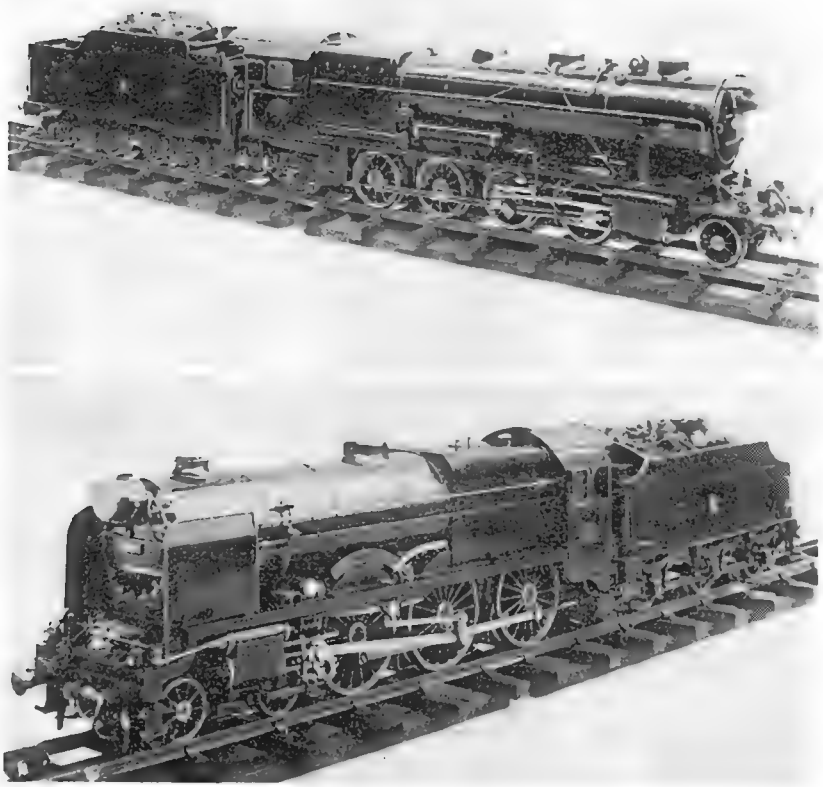
Two useful diagrammatic tables are given in connection with this subject. The first is for the purpose of determining the percentage of a grade, after the American procedure ; the second gives the ratio, according to the British method. The first chart enables you to calculate the percentage for any number of inches rise in any number of track feet. A one per cent gradient is one which rises 1 ft. in every 100 ft. along the level. Thus, if you follow the vertical line representing 100 ft. and the horizontal line representing 12 in. rise, you will find that they intersect at the slanting line labelled one per cent. In the other diagram, you have information as to the length required for a given ratio of gradient, as applied both to a plain rise or fall, and a gradient halved in its length by raising one track and declining the other. The maximum steepness of a gradient allowable for 00-Gauge is somewhere about 1 in 40, and the steepness should be decreased if there is a curve on the gradient. If you can make your grades still less exacting, always do so. They cannot be too lenient.

IMPORTANCE OF RETAINING SCALE

NO DECENT railway modeller temporises with the factor of scale in his work. It should be borne in mind no matter what the feature under constructiom may be that the craft ceases to be intelligent and scientific the moment any out-of-scale expedient is resorted to ; and if this sort of thing is allowed to creep into the work it ceases to be an occupation for mature minds and becomes the thing that most uninitiated folk imagine it to be—child's play. There is all the difference in the world between the scientific modelling which this book advocates and the mere return to the kindergarten spirit on the part of weak-minded adults. One of the tasks ahead of the fraternity of scale modellers is to get their handicraft recognised by the authorities and the intelligentsia of the country as one of the light leisure sciences and arts, and this is precisely what, until now, has not been achieved. The Ministry of Supply and the Post Office persist until this day in classifying all forms of products attaching to the craft along with " children's toys "—a fact which says little for the intelligence of the authorities, perhaps, but which arises from a certain foolish and unwarranted prejudice for which modellers in the past have been partly responsible. It is no unusual thing, when a book devoted to the subject is submitted to a publisher new to the field, for a reply to be received from the juvenile department of the publishing house. The truth is that there is as much kinship between the craft itself and the juvenile interest in miniature trains as there is between the exhibition ship models of a firm like Bassett-Lowke and the sixpenny boats formerly sold by Woolworths ; and there is as much intelligence shown by the authorities in including our materials under " toys " as there would be in their calling a glass case Union Castle exhibit a toy. It is this factor in the reputation of our work that we modellers require to preserve by observing at every point the dignity and perfection of construction.

What, precisely, does " scale railway modelling " mean ? It means the construction of accurate scale models of actual railway features, working from the workshop drawings of the railway companies. Where the element of free designing comes in at all, it must be carried out in the spirit of a challenge to the railway expert to discover any betrayal of the entire science of railway construction. The same fidelity to actual railway procedure attaches to every phase of operation, signalling, architecture, and track as to locomotive and rolling stock design. And wherever this principle is forsaken in any respect we cease to be scale workers.

Even in the field of locomotive design there is such a thing as a " model " and a " scale model." A " model " is a miniature engine which is in a loose and general way a reproduction of what might be a real engine ; it may be a mere boiler and cab on wheels, looking sufficiently like a real



TWO GENUINE SCALE MODELS. Mr. J. C. Miller's 0-Gauge freelance "Mikado" and "Royal Scot."

machine as to pass and be recognised as a small replica of it. But a "scale model" of its full-sized original is a detailed reproduction, as if the original had been photographed and reduced down and thereafter given life, power and three dimensions. Such a "scale model" need not have for its original prototype any one specific example, indeed; but it must, in that event, be a minute reproduction of what such a full-sized prototype would be if it existed under orthodox railway engineering principles. To indicate this idea I have given a couple of photos of true scale models built for Mr. J. C. Miller of Venezuela. One of them is a scale model of an actual example; the other is just as faithfully a scale model of an imaginary Mikado locomotive. Let the beginner, then, resolve to preserve the dignity of the craft by producing accurate and true models of this order.

THE HABIT OF PHOTOGRAPHY IN AND ABOUT LOCOMOTIVE YARDS.
John Ahern with his camera.

GATHERING AND USING IDEAS

PROBABLY THE most essential qualification for a railway modeller is the faculty of personal observation. An evidence of the importance of this qualification is shown in the fact that when you speak to a master in the art, or read an article by a writer like J. N. Maskelyne, you will be astonished at the manner in which he will recall off-hand some striking railway feature he observed as long as 20 years ago when out for a walk,

'00' GAUGE LAYOUT.

Blacked in :- LOW LEVEL — Normal running roads
Hatched :- HIGH LEVEL — Stations, Sidings, etc. and ramps. (Ramps approx: 1 in 60 downs. 1 in 75 up.

Running Roads.

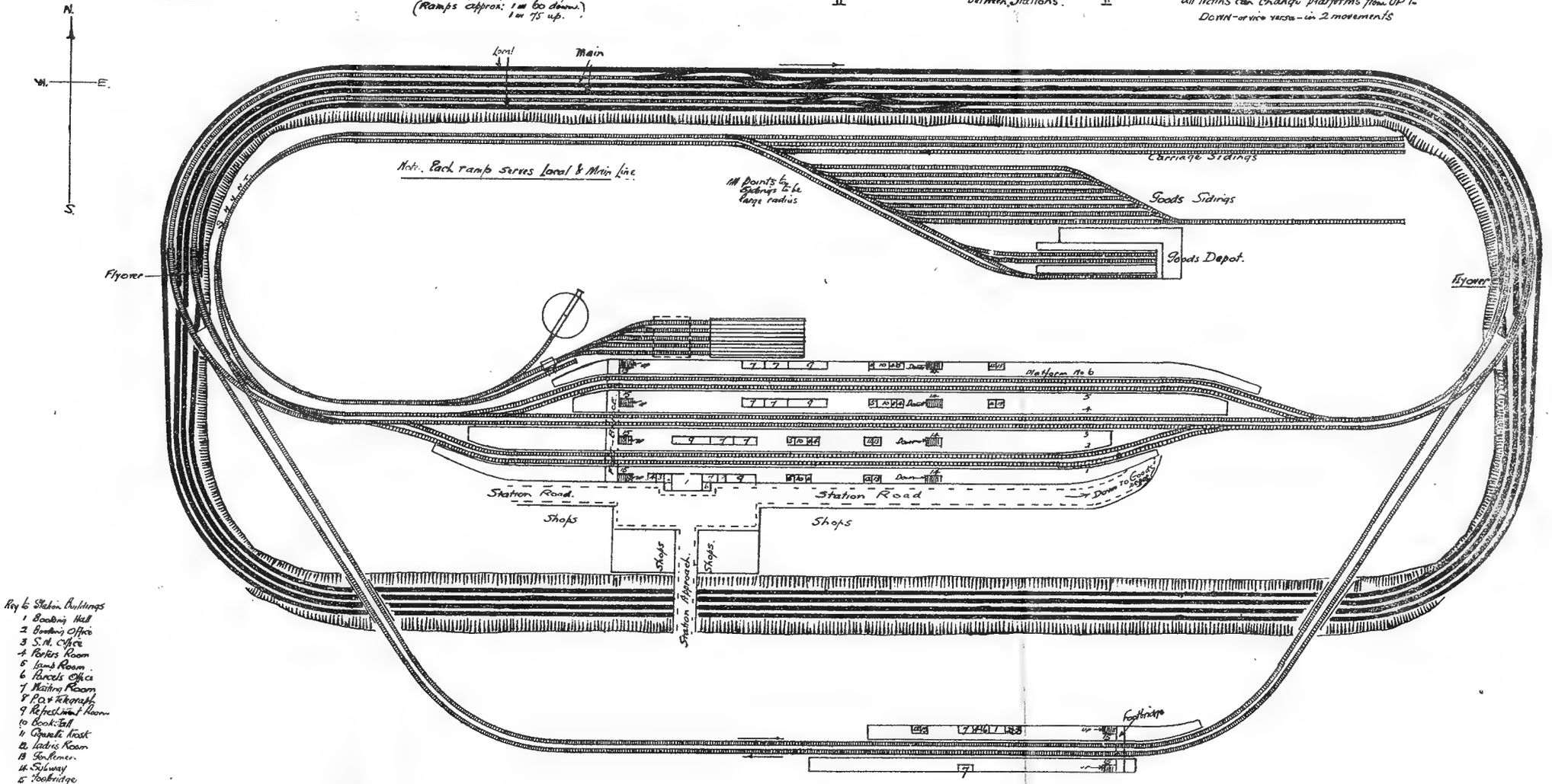
4 tracks - UP & DOWN; MAIN & LOCAL.
Long Straight Section.
No Stations.
1 facing & 1 trailing point per road.
Continuous run of any desired length "Between Stations."

Stations

Only taken when required — and as alternatives i.e. Cannot both be taken same round.

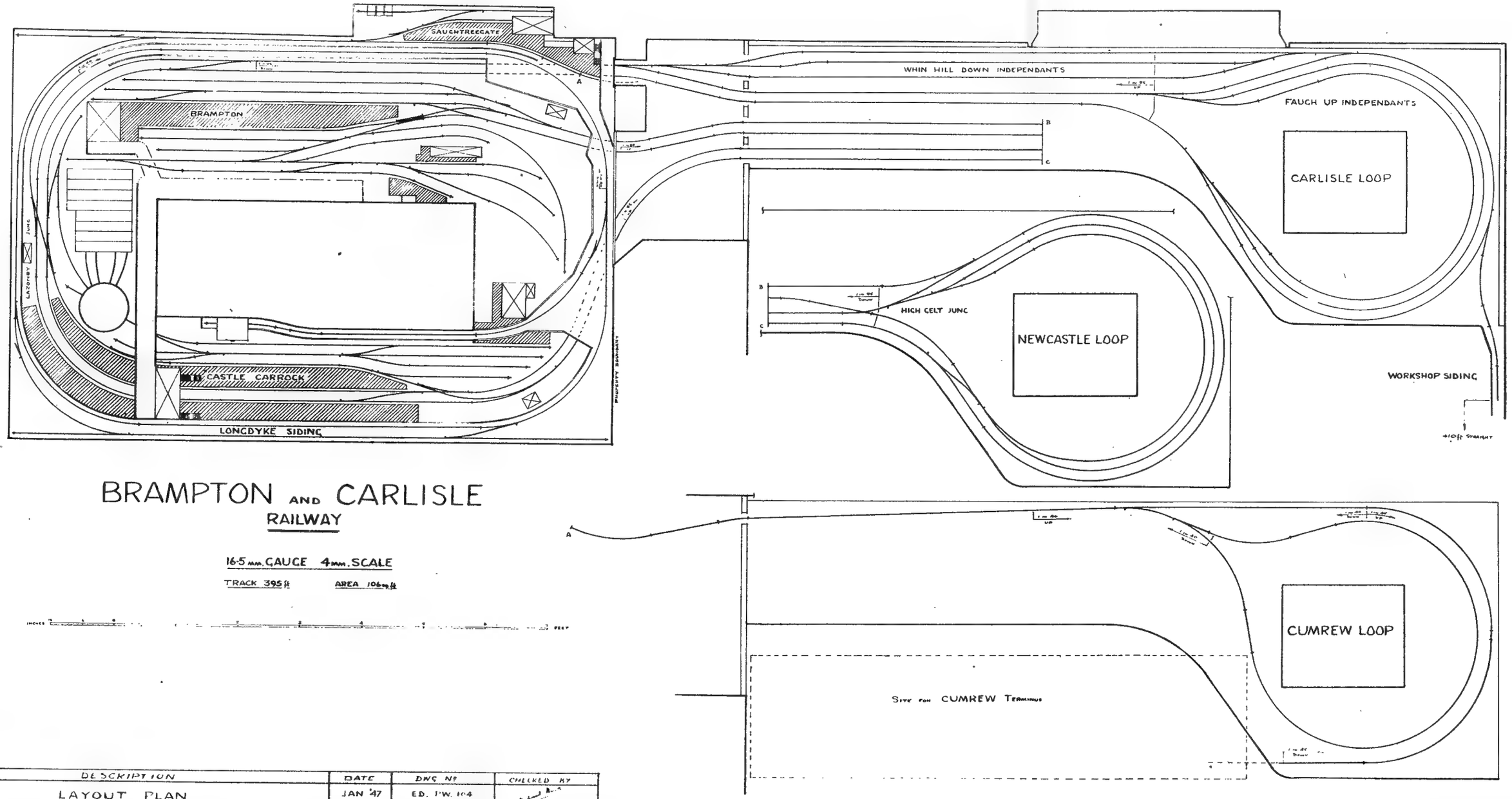
MAIN STATION — Platforms for 12 coach train.
All trains have choice of 3 roads.
All trains can be "cleared" in 1 movement.
All engines can be "cleared" in 1 or 2 movements.
All trains can change platforms from UP to DOWN - or vice versa - in 2 movements

COUNTRY STATION — platforms for 7 coaches.



Scale 1 inch to 1 foot.

J. R. Baillie Richards
88 Benhill Wood Road
Sutton, Surrey.



BRAMPTON AND CARLISLE
RAILWAY

16·5 mm. GAUGE 4mm. SCALE

TRACK 395ft AREA 106sq.ft

DESCRIPTION	DATE	DWG No	CHECKED BY
LAYOUT PLAN	JAN '47	ED. P.W. 104	

and will describe the occasion and the scene with the utmost unerring accuracy. Probably, if all the railways and the men who make and maintain them were bombed out of existence, the railway " observers " would be able to reconstruct the design for them—or at any rate provide the data for the designing. The trained eye rapidly becomes instinctive in its capacity to snap up the unusual, the new, the defaulting element in any railway scene. The journey of a trained observer to London from Scotland is nothing at all like the journey of anyone else. Mental or pencilled notes record everything of outstanding interest *en route*. Station track schemes, new and old wagon or coach types, small characteristic scenic sections, signal cabins, engine sheds, turntables, lamps, platform furnishings, and all the varying paraphernalia of the iron road are laid open to your view.

A developed form of this observation habit is that of photography round and about railway depots. Until recently, the restrictions on this form of activity have been very severe and occasionally quite pedantic. But with the advent of peace these should speedily be lifted. It is a wise course to get permission to take exposures before doing so, if on the grounds of courtesy alone. The enthusiast, whether he is a cameraman or not, will also do well to cultivate the useful art of rough sketching in pencil, so that exact scenes can be transmitted to paper and thence to the layout. Word-pictures alone are useful, also. Six excellent ideas of wayside " constructional jobs " came under my notice on the last railway trip I made—a fabricated factory under construction, a row of " pre-fab " houses, an excavator job with a giant steam shovel at work, and so forth. It is thus that the realistic touch in modelling can alone be secured ; and there is always immediate evidence, on visiting a layout, whether it belongs to an " observer " or to a merely pedestrian " modeller." There is an art, too, in knowing the kind of useful pictures to take with a camera. Two such photos I have included herewith. It will be noticed that they include detail rather than general vista, and that the subjects are somewhat different from those to be found even in the best of railway periodicals. These pictures were taken by Mr. J. Stuart Morris at Perth, on the occasion of a visit by the writer to the late Mr. Harvey Riach, Chief District Engineer of the L.M.S. It will be noticed how the picture of the cinder plant contains just that wealth of detail so invaluable to the modelling enthusiast. Enginemen's recreation and refreshment rooms, standpipe, pits, ashplant, telegraph poles and their footrests, point levers, several wagons, one or two of which have repaired and re-painted side planks and one of which is new—these details are exactly what is required and have repeatedly served for reference. In the other view, we have what every builder of model coaling plants has always wanted—a close-up of the wagon-tippler in the act of doing its job. The least valuable type of picture is that of the train in motion, unless indeed there are trackside details that are worthy of note. I have spent many years in trying to collect the right type of railway picture ; but out of generous batches periodically received from the leading railway companies of America and the publicity people in this country, the number of star items is very low. Photos of locomotive depots, at close range, of signal cabins, passenger platform equipment, freight sheds and yards, small trackside buildings—none of these will be found so common as the popular

SUBJECTS SOMETHING DIFFERENT FROM THOSE USUALLY FOUND IN THE RAILWAY PERIODICALS.

views of running trains, wagon building shops, coach interiors, and so forth.

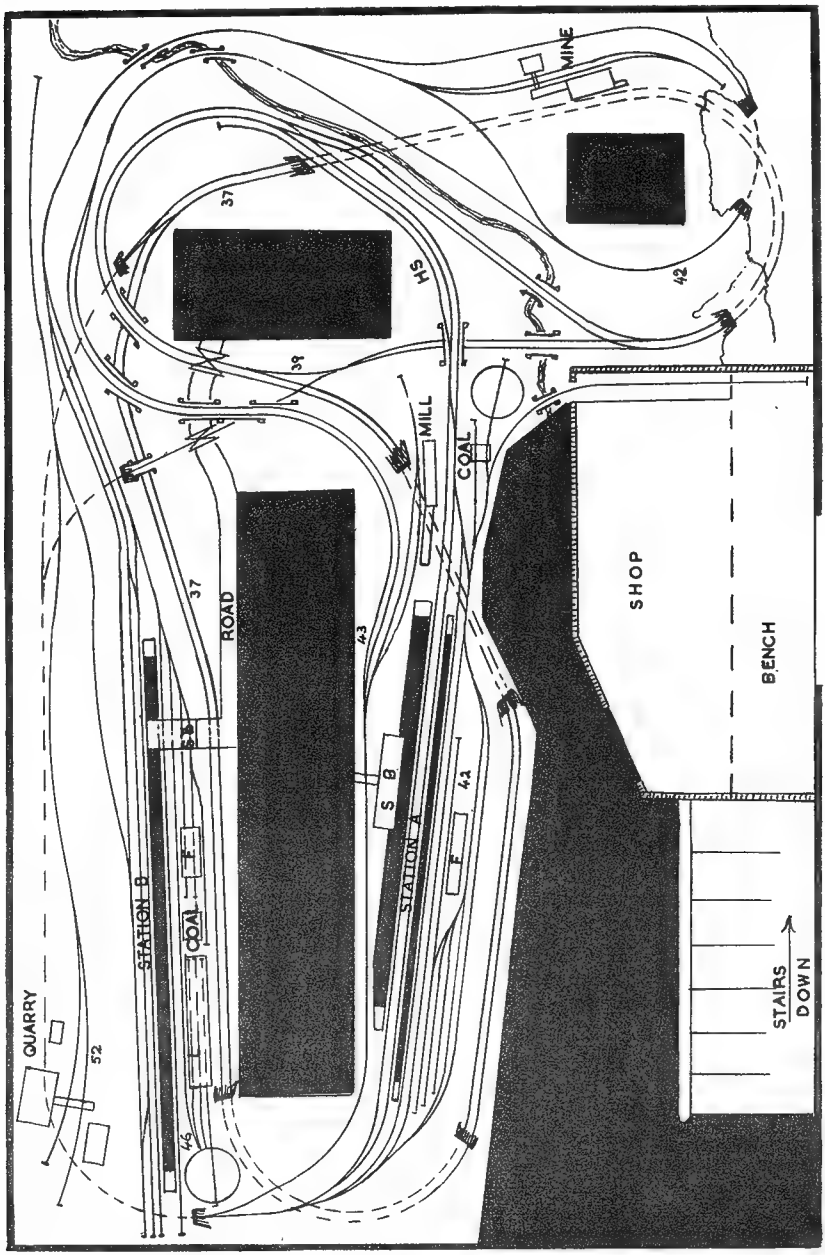
In short, it is the kind of railway photograph which you do not see elsewhere that should be snapped up by the model-worker. And it is the genius for taking such pictures after they have been discovered that ultimately sets the hall-mark of realism on a layout.

WHAT IS THE IDEAL SITE ?

THE IDEAL SITE for a miniature system would be extremely difficult to describe in any hard-and-fast terms. There are so many ways in which the notion of an ideal situation might be interpreted. There is the perfect salon, specially designed and built by the man of means for the purpose ; there is the makeshift location eagerly seized upon by the person not quite so fortunate and converted into more or less comfortable head-quarters for his work. For the present, we will exclude the first type of location from our thoughts, for it will be considered later in this series ; and we will restrict ourselves to something more modest and generally accessible.

Many enthusiasts tend to be over-pedantic in their search for suitable premises for a layout. It may be here stated that it is far better to obtain the use of some discarded building having four walls and a roof that excludes moisture, than it is to strive for the use of one of the apartments in a dwelling house where space is at a premium. For one thing, if the building is of the first type, it becomes more or less the exclusive property of the worker, and he can renovate, convert and improve it entirely to his private taste. It will also probably be situated away from dwelling quarters, so that noise, dirt and occasional upheaval will be no offence to anyone. Again, it will give no inconvenience to any third party when visitors are received at such a rendezvous. If one is so fortunate as to find a small hutment, vacant garage or—most desirable of all—a loft over a stable of the old familiar type, the rent or purchase price should not be excessive ; and if, in the case of renting, a lease covering a period of a few years can be obtained, so much the better. There are certain internal requirements that are important. The place should have a flooring of comparatively warm material if possible ; concrete is cold in the winter. It should be possible to lay on electricity for heating and lighting, the best form of heating being the tubular kind, placed near the floor. Tubular heating is inexpensive to instal and to maintain, and can be left in operation when the building is not in actual use. Skylights are preferable to side windows, for they do not break up the backscreen and they let in the daylight where it is required. The best form of artificial lighting, of course, is of the neon kind, though the cheaper form of pendant bulbs can be perfectly adapted to the use of the site. Needless to state, the building should be sufficiently robust to defy easy theft. Area is an optional matter, though, within reasonable restrictions, the larger the space, the better. There should be plenty of headroom. Granted these conditions, all that is needed is a weather-proof combination of four walls and a roof.

The ideal ready-made site would be a stable loft such as I have already mentioned. Being on a first floor it would be dry and more or less



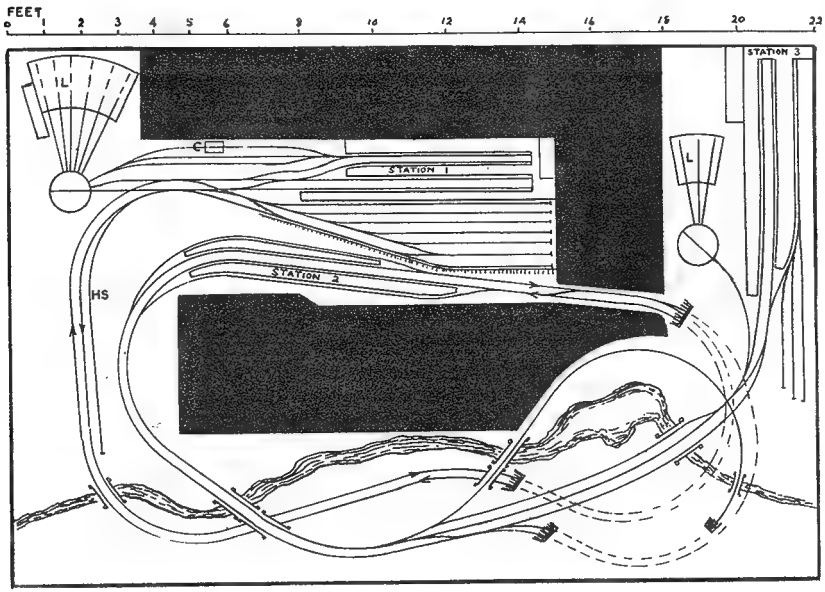
DESIGN FOR AN IDEAL LAYOUT 25 *ft.* × 17 *ft.*

isolated ; its size would be about right, its rental low. For such a location as this I have given a layout scheme which I think would ideally fill the bill. In the plan I have allowed for the stairway leading from below, and have arranged for a small workshop section to be screened off from the main area. Within this shop space there would be ample room for working on the small jobs which are always emerging. A good skylight or side window would be requisite to serve this apartment. The rest of the area, about 25 ft. by 17 ft. is given over to the tracks and access spaces. The layout is most excellent, and owes a great deal to a design by Linn. H. Westcott of the " Model Railroader," particularly as regards main-line section to the right. There are two stations only, and they will be found ample for excellent operation. The outstanding feature of the plan is the extraordinary length and interest of the main-line runs from station to station, or out and home, as the case may be. There are several good reverse movements which provide extended distances. The stations, one a terminus and the other a through, are quite commodious, with all the facilities demanded. Good, hefty trains can be accommodated at the extensive platforms. There are several industrial sites—a mine, a cotton mill and a quarry, the latter being approached by means of a climbing reverse, or zig-zag road. The numerals at certain points indicate clearly the height of the tracks above the floor level of the room at these places, so that a definite idea of the gradient ratios can be had. There is a spur from the locomotive tracks at station A, running off into the shops, so that the lifting and carrying of rolling stock is averted. The height of the baseboard (lowest level) above the floor would be about 3 ft. It will be seen that trains can be run in both directions to and from both stations, as well as out of either station and back in again. There is also a continuous run on the main line to allow all trains an indefinite length of journey.

Such a layout, on a site of this kind, is by no means the prohibited luxury generally imagined. A search around your neighbourhood would, even in these days of housing shortage, probably be well rewarded. Failing one like it, a vacant garage lends itself to ready adaptation, or even a large sectional timber hut.

Another layout, within slightly smaller dimensions, is that designed for an American craftsman, B. W. Storr, which I have modified to suit British procedure. The space here is about 22 ft. by 15ft., the scheme being far less ambitious and the area much less occupied than in the former instance. There are here three stations, two of them being of the terminus type. The main line run is of considerable interest, and is of the continuous order. Ample space is allowed for scenic and industrial developments. A large garage or similar building would form a good site for this scheme, which can also be conveniently arranged within a house room.

It should be remembered by the prospective worker who is restricted as to finance, or who does not care to assume the responsibility for renting a site, and whose home does not contain any vacant space, that it is a good plan to join and co-operate with someone else in the undertaking. Two men can work better than one, and two can share responsibility and provide ideas more conveniently than a lone worker. In carrying out the work of construction at some site away from home, though it be only 50 yards away,



LAYOUT OF B. W. STORR OF PHILADELPHIA. With acknowledgments to L. H. Westcott. Modifications for British practice.

he is liable to find it a somewhat solitary task. But if two, or even three, such enthusiasts are co-operating, the case is entirely different. Furthermore, three heads are better than one in discovering a site. If the numbers of co-workers are kept as low as this, there will hardly be any necessity to formulate club conditions; the arrangement for partnership can be quite informal, and stock can be jointly held on the understanding that if anyone retires from the scene he leaves behind him his share of the spoil for the benefit of his friends.

PERSONNEL OF THE CRAFT

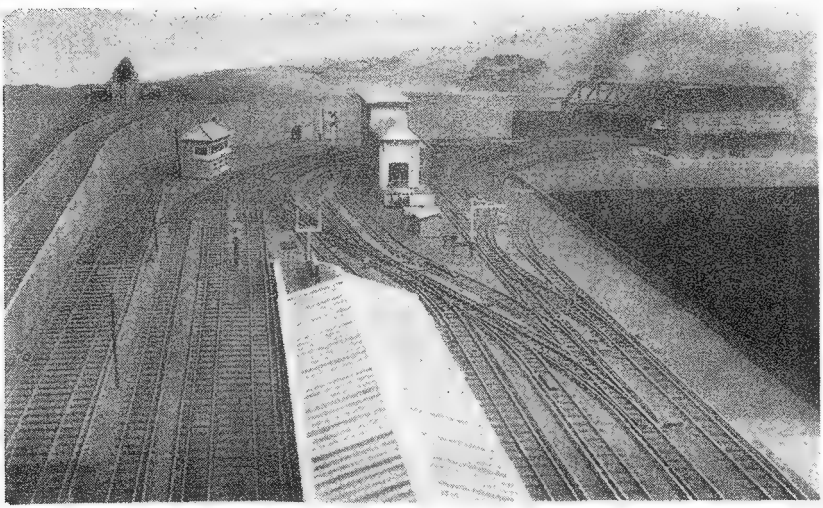
THIS BRINGS US naturally once again to the social side of the interest, and verges upon the subject of club life. It may be well to include for the benefit of the beginner some idea of the extent of the club influence in this country and elsewhere. During the somewhat barren war years there was not much progress in this respect, but since the cessation there has been a quite remarkable advance and an equally encouraging return of

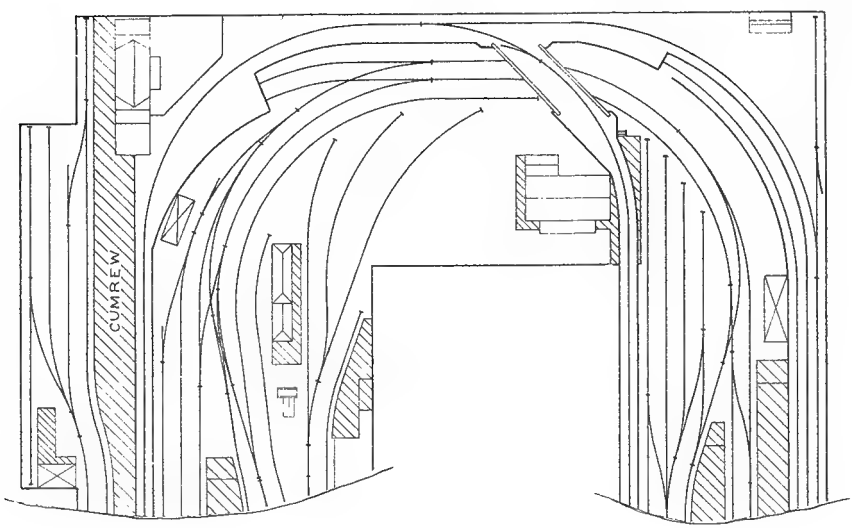
those whom the war had scattered. It is probable that within easy reach of your town or city or village, wherever it may be, there is now a club at your disposal. London, with its separate suburbs, Manchester, Birmingham, Bristol, Hull, Newcastle, Liverpool, Edinburgh, Glasgow, and scores of other centres are well served. Some of the most progressive societies are in the London outskirts—at Wimbledon, Harrow, Romford and elsewhere. But, at all events, by writing to any one of the editors of the various journals devoted to the craft, you can readily find out what is your own nearest existing centre; and should you prove to be unfortunate in failing to find a convenient one within reach, there is nothing to prevent your inaugurating one yourself by means of an advertisement in one of the aforementioned papers. A very valuable cheap handbook has been recently published by Modelcraft Ltd., in which the formation of such a club from scratch is made a most congenial and simple procedure.

It is excellent, also, for the beginner to know at least a little as to the fraternity he proposes to enter. I could write a vast screed concerning the brotherhood of railway modellers, indicating their deficiencies and dwelling on their virtues. It used to be said that all railway modellers were temperamental; and while the epithet, like all others of its kind, is no doubt a gross exaggeration—especially in view of the ever-increasing number of recruits—there is a modicum of truth in it. It has already been laid down here that some form of mental reaction is the primary impulse leading people to turn to this handicraft; and it is essentially the temperamental man who is liable to such a reaction, to such a rebellion against some form of rigid concentration in other spheres. But, having said this, it seems to me to be all there is to be said upon the subject. Personally, I have found my fellow craftsmen in the fraternity among the very best and finest people I know. It is an excellent thing, also, for anyone to find friendships among a company of folk who are not specifically of one's own essential turn of mind on every subject. Otherwise a man grows up to be one-sided and ignorant of the true nature of the bulk of mankind, merely having restricted himself to people who belong to his own narrow and exclusive category.

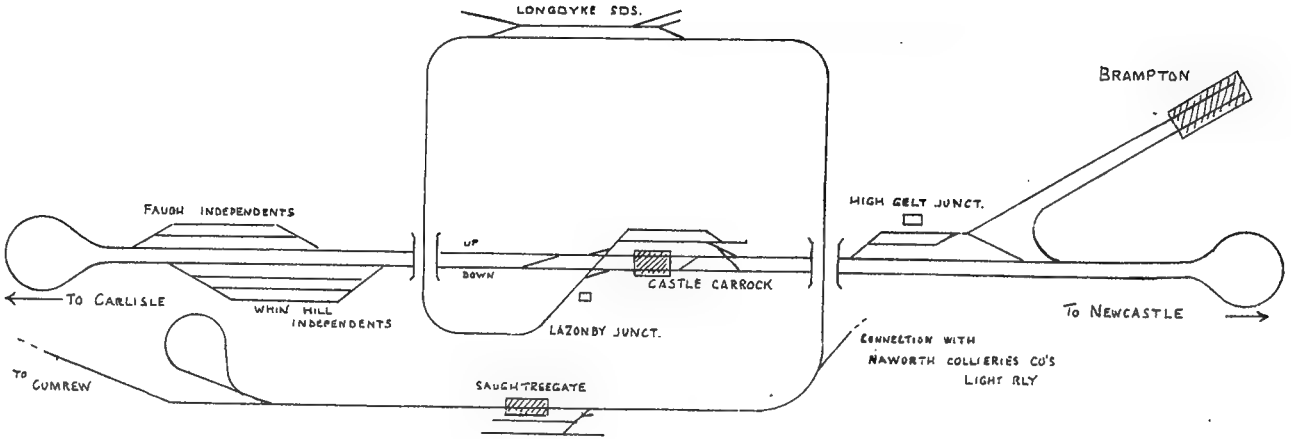
Within certain natural limits, then, to begin this work is to bring oneself immediately within the circle of all types of people who are willing to fraternise and to help. There are few veterans who will not send an enlightening reply to any query on the craft that is sent with a stamped envelope. I doubt, indeed, if there are any, unless they are prevented by the sheer overwhelming weight of such correspondence. And I think this speaks well for the brotherhood.

The beginner would also perhaps like to know something of the work of one or two of the more experienced modellers. Some of their layouts are the result of many years' experiment, reconsideration and rebuilding. A notable example of this kind is that of Capt. Fleetwood Shawe, who has followed the interest since he was a child, and at 12 years of age produced work that would put to shame many a middle-aged craftsman. At 16 years of age he designed his present system in a very small room which most workers would have set aside as inadequate. Within this space, however, he created a perfectly operating model on which automatic coupling and uncoupling was faultless, on which there were locomotives,

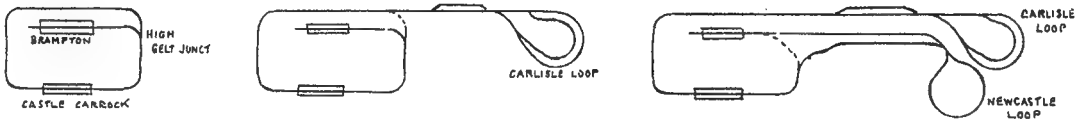




THE EASTERN SIDE OF CAPTAIN FLEETWOOD SHAWE'S ORIGINAL LAY-OUT—WHERE THE CRUCIAL ALTERATIONS HAVE BEEN MADE. This photograph and plan should be studied in conjunction with the route diagram on page 36 and the layout plan on the inset sheet.



PRESENT ROUTE DIAGRAM



ORIGINAL ALIGNMENT | 1ST PHASE | 2ND PHASE

BRAMPTON & CARLISLE RAILWAY

Study this route diagram in conjunction with the plan on the inset sheet and the photograph and plan on page 35.

signals and rolling stock of immaculate design. Much of this work I have from time to time described elsewhere. But since the recent war, on his return from railway duties with the Royal Engineers abroad, Capt. Shawe has made extensive improvements to an already fine piece of work, having taken in part of an adjoining room and provided the somewhat cramped layout with long main-line tracks and waiting loops. I have pleasure in being able to give an excellent plan of the entire scheme, as well as route diagrams to elucidate the general function of the layout.

The railway represents a working model of an imaginary full-size line located in actual country. Place names are genuine ones, and are in correct geographical sequence. The Carlisle and Newcastle loops have been built and put into traffic during 1946. The work was carried out with a minimum of disturbance. Capt. Shawe assures me that the Brampton-Castle Carrock section was only closed for 24 hours ! There are now 360 ft. of line in traffic, and there still remains the Saughtreegate-Cumrew loop to be installed. Cumrew terminus will be portable, and will be arranged to fold within an 8 ft. by 2 ft. 6 in. cabinet. The Carlisle loop, together with Whin Hill and Faugh loops are remotely controlled from a C.T.C. board at Castle Carrock. So are High Gelt Junction and Newcastle loop.

It need hardly be stated that the reconstruction has completely revolutionised the line from an operating standpoint. But Capt. Shawe states that the scheme required most careful and detailed forethought, having been under consideration for over four years. The securing of the various levels and curves was a tricky job owing to lack of space. The main line, in effect one continuous single line, is 113 ft. in length, and four trains can be worked over it simultaneously—a most spectacular display ! Automatic block signalling will be installed—as the owner expresses it—" to relieve nerve-strain."

The new form of track-laying is a notable feature. After a careful examination, and after some hours of operating the system, I can truthfully state that the running of trains is completely without sound. To hear the wheels turning one has to listen. The method is that of laying the tracks loosely, from the standpoint of rise and fall, on common table-baize suitably dyed to a dark brown shade. This is cut in strips to represent ballast, and the sleepers rapidly set down into the material in a most effective manner. The rail being loose, and there being no downward grip on the baseboard, reverberation and echoing are entirely eliminated.

As will be seen, the new sections provide not only a lengthy main-line run, but waiting loops for manipulating slow and passing trains in all directions. There is also a branch line leading to the adjacent workshops. Carlisle and Newcastle terminals are, of course, imaginary ; and this idea in itself is most commendable. It is not possible within the ordinary limits of the usually accessible space to plan adequate models of large actual termini, and there is much more satisfaction in confining one's interest to modestly-proportioned stations that can be worthily treated as models. This layout of Capt. Shawe's is the first I have seen in which this obvious fact has been given recognition. The effect is that of operating local and through traffic at existing way-stations, as it emanates from imaginary railway centres of vaster importance.

My purpose in including a brief description and drawings of this extended line here, rather than later in this series, is simply to show how an existing layout can be extended without altering the basic features, such as stations and their relationship to each other, as originally laid down in the first plan. It will also serve to indicate that although when the initial scheme is executed there appears small hope of anything further in the way of available space, and the whole of the existing terrain seems to have been occupied, time may bring its opportunities. The hint to be taken from this fact is for the beginner never to plan his layout as if it were to be built for all time, but to remember that subsequent developments are always possible, and that the work of demolition and reconstruction, of improvement and extension, is just as interesting and important as that of original planning.

Another most excellent new layout design is that of Mr. J. R. Baillie Richards of Sutton, Surrey. In this instance, the builder found himself in possession of an excellent site of an area enclosed within 30 ft. by 16 ft. Sticking to the smaller scale (00-Gauge), Mr. Richards has succeeded in getting a most comprehensive layout, with ample space for extensions and for scenic features, and has been able to include some really commodious facilities. Notable amongst these is the large freight station approached by a subway street from the front of the main passenger terminal. The main-line tracks comprise four running roads, up and down and main and local, on which there are happily no stations, so that continuous running can be had without passing any facilities twice over on the same journey. Main-line points are reduced to a minimum, there being only one trailing- and one facing-point per road. The continuous run can be taken on any journey between stations. The stations are so placed, again, that they can only be taken as alternatives ; that is, they cannot both be taken on the same round. At the main station the platforms will accommodate trains of 12 coaches each, and all trains have the choice of three roads. In one movement, any train can be cleared at any time. All engines can be cleared in one or two movements, and all trains can change from up to down platforms in two movements. The country station will take trains of seven coaches. There are extensive coach storage tracks and excellent locomotive facilities ; there is no place where the main lines cross one another at the level. I consider this to be one of the best comprehensive schemes I have seen, demonstrating what can be done with 00-Gauge in what I might term a modestly generous space.

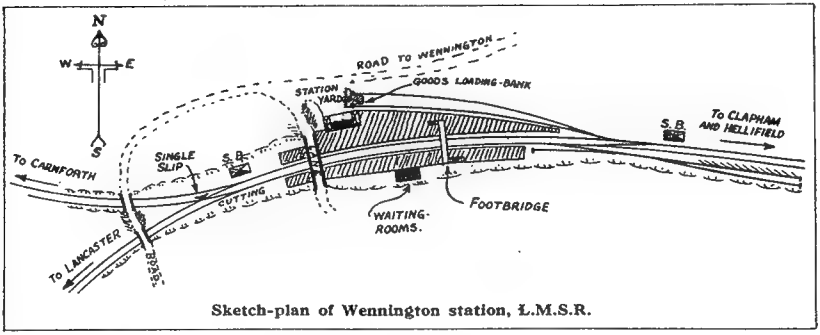
With these two designs, one for a new line and one for extensions to an old layout, the beginner will be able to form an idea of the standard at which to aim.

SOME HINTS ON LAYOUT DESIGNING

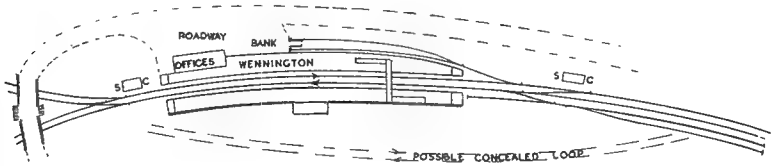
HAVING MADE reference to the need of observation, and having given one or two typical examples of what a layout should be like, it may be helpful to touch upon some practical aspects of designing one's own layout, and of transforming the results of one's observations into such form as will be amenable to the restrictions of the space at liberty.

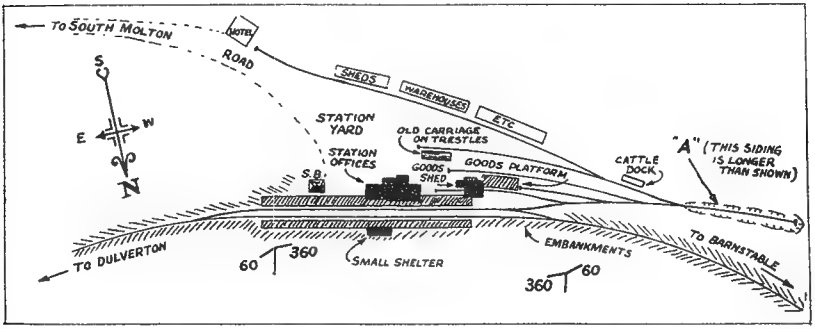
It will be obvious, in the first place, that it is impossible to model any ordinary station layout from actual life, absolutely to scale, within common baseboard restrictions. An ordinary country station, modelled to a scale of 4 mm. to the foot, would probably require a length of over 20 ft. in itself. When larger originals are tackled the amount of area proportionately increases. I have given one or two examples of existing small stations which were published some time ago in the " Model Railway News," and have also made the attempt to reduce and accommodate them to railway modelling usage. This work is really an art in itself; but it is better to learn the art than for the beginner to work absolutely to imagination in his designing; for there is comparative safety in modelling an original rather than in trusting merely to one's fancy in these matters. There are two principles which come into effect. One is that there will be a need to abbreviate the total length of the original, allowing space of the longest probable train to be operated; the other is that the liberal use of space between tracks and width in general to be seen in actual instances will require to be curtailed, the tracks being brought more closely together into parallel, while allowing for the necessary cartways and so forth. A consultation of the sketches will illustrate this point. It will be realised that, in this way, quite commodious yards can be satisfactorily and more or less faithfully copied. The great thing is not to overdo the compression so as to restrict any kind of operation of traffic.

Another matter in layout designing is still more interesting. The reader will find that I have also given two other diagrams, one of a layout in outspread form, the other of the same scheme compressed, as it were, to go within a given area. The idea is to draw in pencil the desired arrangement of tracks, not necessarily indicating the position of bridges and so forth, but simply overlapping the tracks to secure the needful runs and the location of stations and main lines. Then proceed to twist the arrangement, so to say, to fit the conditions. The plan of the completed layout is the result of this process applied to the outspread scheme. The plan given earlier for a multiple-company club layout would also stand a considerable amount of this adjustment. It will be readily revealed during the process exactly where the tracks will require to cross each other, and at what places bridges and gradients and tunnels will be demanded. It will be advisable, also, to keep the original pencilled skeleton plan, as it will

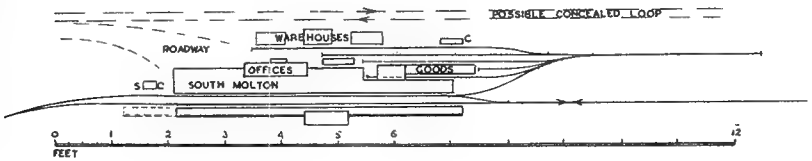


Sketch-plan of Wennington station, L.M.S.R.





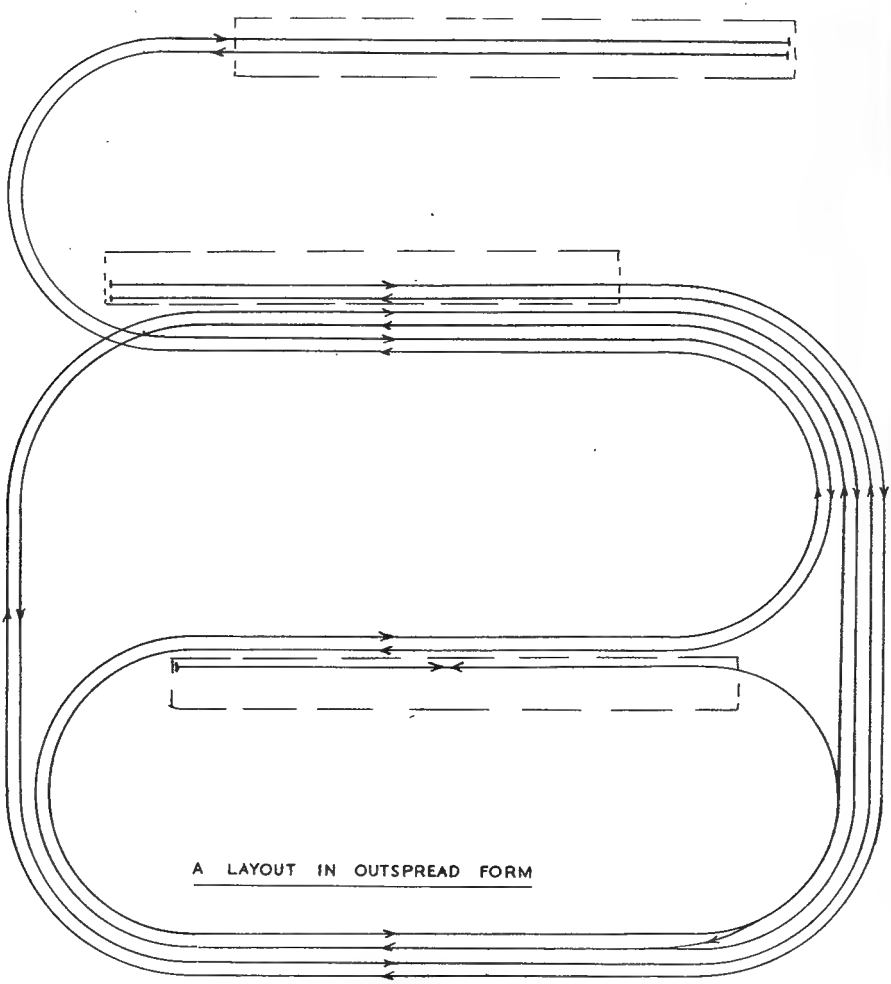
Sketch plan of South Molton Station, G.W.R.



ACCOMMODATING ACTUAL STATIONS TO MODEL RAILWAY USAGE.
Adaptations from real station layouts published in the "Model Railway News."

be found useful at a later stage when a track diagram is required for the control board.

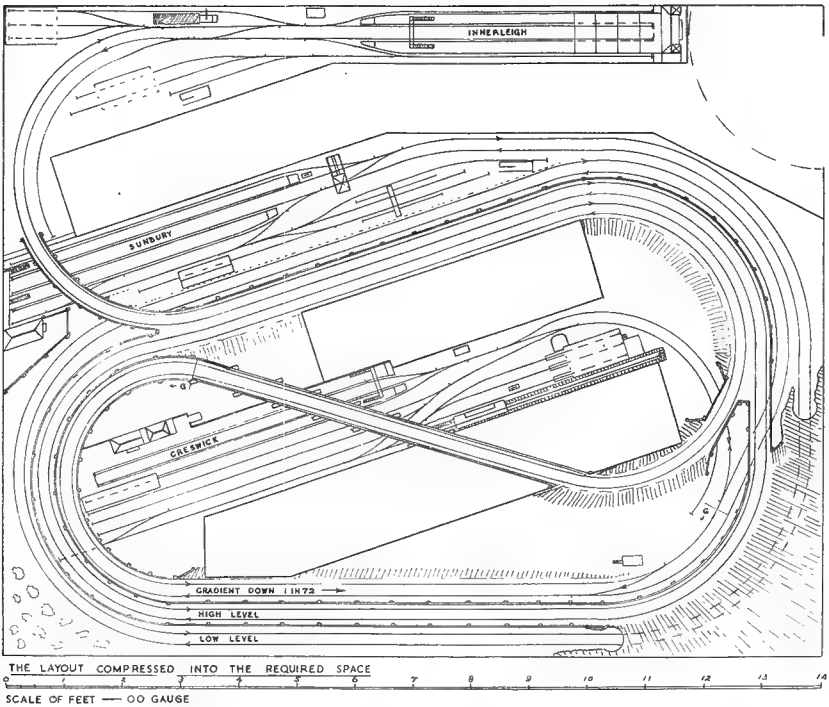
I do not propose to enter in detail upon the various drawing apparatus required by the model draughtsman; the subject has been treated often in its own sphere. Suffice it to be stated that there will early be found a demand for suitable scale rulers, and that these can readily be had marked



THE CONDENSED FORM OF THIS LAYOUT IS SHOWN ON THE OPPOSITE PAGE.

out for the particular scale to which you are working. If possible, secure a 9-in. ruler rather than a 6-in. One or two sets of French curves are also almost indispensable, together with celluloid set-squares, T-square and drawing board.

There are also correct conventional signs available to the designer of model layouts—the same series as used by the railway draughtsman and engineer. These include the signs used to indicate embankments, tunnels, fences, culverts, track, level crossings, and so forth, and while they need not be slavishly adhered to in our work, they are advisable.



THE LITERARY FIELD

THIS IS ALSO the place, while discussing the general approach to the craft, to indicate the range of literature available for the man about to start. It is good to know that during the past decade there has been an enormous increase in this literature; and we will divide our survey into more or less independent sections covering both the American and the British spheres.

There is first the type of book dealing with the whole subject in a general introductory manner :—

British.

"The Model Railway Handbook" by W. J. Bassett-Lowke.
"Model Railways" by H. Greenly (Cassell).
"Working Model Railways" by E. F. Carter (Marshall).
"Indoor Model Railways" by E. W. Twining (Newnes).
"The Craft of Modelling Railways" by Edward Beal (Nelson).
"Scale Railway Modelling Today" by Edward Beal (Black).
"New Developments in Railway Modelling" by Edward Beal (Black).
"Railway Modelling in Miniature" by Edward Beal (Marshall).

American.

"Model Railroad Engineering" by D. Marshall (Appleton-Century).
"Model Railroads" by E. P. Alexander (Kalmbach).
"Building a Model Railroad" by Coolidge (Macmillan).
"How to Build a Model Railroad" by Loose (Model Craftsman Corp).
"Making and Operating Model Railroads" by Yates (Appleton-Century).
"Model Railroads in the Home" by E. C. May (Funk & Wagnalls).
"Model Railways" (Popular Science Co.).
"Handbook for Model Railroaders" by Walthers (Kalmbach).

★ ★ ★

There are also numerous works which treat specialised railway modelling subjects, and which may be thus listed :—

Layout Design.

"Choice of Scale and Gauge" by L. H. Westcott (Kalmbach).
"Track and Layout" by A. C. Kalmbach (Kalmbach).
"Planning and Layout" by H. Greenly (Marshall).
"Railway Modelling in Plan and Perspective" by Edward Beal (Modelcraft).

Locomotives and Rolling Stock.

"Model Locomotives and Cars" by Edward Beal (Kalmbach).
"Building a Model Passenger Train" by M. Thornburgh (Kalmbach).
"Model Locomotives" by H. Greenly (Cassell).
"Cardboard Rolling Stock" by E. R. Gray (E. R. Gray).

Scenic Work.

"Scenic Railway Modelling" by P. R. Wickham (Modelcraft).
"Miniature Building Construction" by J. Ahern (Marshall).
"Building Paper Realism" by Edward Beal (Modelcraft).
"Pictorial Model House Modelling" by E. W. Hobbs (Crosby).
"How to Draw Houses" by S. R. Jones (Studio).

Structures.

"Twenty Model Railroad Projects" by F. Taylor (Kalmbach).
"The Model Railway Right of Way" by O. W. Wilson (Kalmbach).

Electrical Work and Signalling.

"Model Railway Electrification" by E. F. Carter (Model Railway Constructor).
"Signals and Signalling" by H. Greenly (Marshall).
"Electric Model Railways" by E. F. Carter (Marshall).
"Signal and Control Manual" by Walthers (Kalmbach).

Operation.

"How to Run a Model Railroad" by Boomer Pete (Kalmbach).
"Book of Rules for Model Railroaders" by L. Sagle (Kalmbach).

Photography.

"Photographing Models" by J. Ahern (Marshall).

★ ★ ★

Apart from the items which deal specifically with the craft itself, there are countless books which have for their subject actual railways, and which deal with these from an angle useful to modelling enthusiasts :—

Textbooks.

"Railway Construction" by W. H. Mills (Longmans).
"Modern Railway Operation" by D. R. Lamb (Pitman).
"Modern Locomotives of the L.M.S." by Barrie (L.M.S.).
"Great Western Railway Engines" (G.W.R.).
"Southern Railway Locomotives" by Kidner (Oakwood Press).
"Railway Signalling and Communications" (Railway Pub. Co.).
"First Principles of Railway Signalling" by Byles (Railway Pub. Co.).
"Railway Signalling" (Transportation Press).
"Railway Engineering and Maintenance Cyclopedia" (Simmons-Boardman).

Popular British.

"Locomotives and their Work" by Allen (Shaw).
"Railway Building" by Allen (Shaw).
"Railways of Today" by Allen (Warne).
"Railways for All" by Gairns (Ward, Lock).
"The Ways of our Railways" by Grinling (Routledge).
"Railways" by Way and Green (Wells, Gardner).
"Conquests of Engineering" by C. R. Hall (Blackie).
"British Railway Rolling Stock" by Webster (Oxford).
"Our Home Railways" by W. J. Gordon (Warne).
"Civil Engineering Today" by Cressy (Oxford).
"Railways of Today" by Williamson (Oxford).
"British Locomotives Illustrated" by Bell (Black).
"British Railways" by Greenleaf and Hayden (Muller).
"Narrow-Gauge Railways in North Wales" by Lee (Railway Pub. Co.).

Popular American.

"Railroad Photographs" (16 vols.), (Kalmbach).
"Trains" by R. S. Henry (Bobbs-Merrill).
"The Story of Bridges" by Black (McGraw Hill).
"The Story of Tunnels" by Black (McGraw Hill).
"Trains, Tracks and Travel" by Metre (Simmons-Boardman).
"Railroading from the Head End" by Farrington (Coward-McCann).
"Railroading from the Rear End" by Farrington (Coward-McCann).

This list is, of course, almost inexhaustible when it deals with books of the latter kind; but in selecting a few I have confined the selection to those essentially useful to the fraternity.

★ ★ ★

Of magazines and periodicals exclusively devoted to the craft there are the following :—

British.

"The Model Railway News" (Marshall & Co.).
"The Model Railway Constructor" (H. Marshall).

American

"The Model Railroader" (Kalmbach).
"The Model Craftsman" (Model Craftsman Corp.).

There are other journals in which occasional reference is made to miniature railway work :—

"The Model Engineer" (Marshall & Co.).
"The Modelcraft Magazine & List" (Modelcraft).
"Popular Mechanics" (Newnes).
"Railways" (Fowler & Co.).
"The Railway Magazine" (Railway Pub. Co.).

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And there are finally the magazines which deal with actual railways in an authentic manner invaluable to model-makers :—

British.

"The Railway Magazine" (Railway Pub. Co.).
"The Railway Gazette" (Railway Pub. Co.).
"Railways" (Fowler & Co.).

American.

"Trains" (Kalmbach).
"Railroad Magazine" (Munsey).
"Railway Age" (Simmons-Boardman).
"Railway Mechanical Engineer" (Simmons-Boardman).
"Railway Signalling" (Simmons-Boardman).

★ ★ ★

Prior to the recent war there were numerous catalogues issued by the model-making firms, some of which had assumed almost cyclopaedic proportions. There are evidences that the return to normal conditions will again bring them into circulation. The more popular ones in size were by Bassett-Lowke Ltd., Bonds Ltd., Hamblings, and the Leeds Model Co., along with American firms like Lobaugh, Model Structures, Walthers, and Scalecraft. Other firms publish smaller and very useful lists : Mellor, Gray, Multi-Models, Zenith, and kindred manufacturers. All are indispensable to the craftsman.

It should be borne in mind that there are many ranges of blueprints obtainable in all the scales, so that working to full-size drawings is made quite practicable. Prominent among such products are the work of J. E. Skinley, Bassett-Lowke, Edwards Bros., Rocket Precision, Hamblings, and Bonds. One or two new series have come into the market since the end of the war, notably a very high-class and extensive range by Modelcraft, covering all manner of buildings to scale, and by John Ahern dealing exclusively with model architecture. Skinley's drawing series has also been greatly enlarged.

HOW AND WHERE TO START

AT THE IMMEDIATE time of writing, there is a shortage in all metal materials, so that it is a slow process obtaining rail, chairs, sheet metal in any quantity, and other raw stuff for modelling. Because of this fact, and maybe owing to the difficulty of obtaining a suitable site for a layout, many keen enthusiasts may be wondering what steps to take towards the realisation of their schemes. It is as well, therefore, to bear in mind that track is not the only thing required. There is nothing at the present time interfering with the supply of materials needed for rolling stock, locomotives, scenic features, structures like locomotive sheds, station buildings, signal cabins, and all the " real estate " for a layout. Nor is there anything to prevent the levelling up of the roadbed for the permanent way, erecting bridges and tunnels, and in working right down to an artistic finish on landscapes. Backscreen work is also something that requires to be completed before the foreground is undertaken.

Actually, it is a wise course not to begin to lay track until some time has been devoted to the planning of several possible schemes as alternatives. Here then is something to be going on with in the meantime ; and when a satisfactory layout has been committed to paper, the project can be allowed to lie for reference while the worker gets on with individual items. Literally years of work can be put into these—each feature being its own intrinsic reward—until such time as track materials are available.

The great motive should, therefore, be to get started on some definite piece of designing or handiwork. It will then be found that enthusiasm, instead of waning and wavering because of contemporary setbacks, will grow stronger with each task performed. It cannot, in the nature of things, be long before materials will be released, and before people will once again be able to live an untrammelled life, untroubled by the irksome controls which have for so long made their hearts sore.

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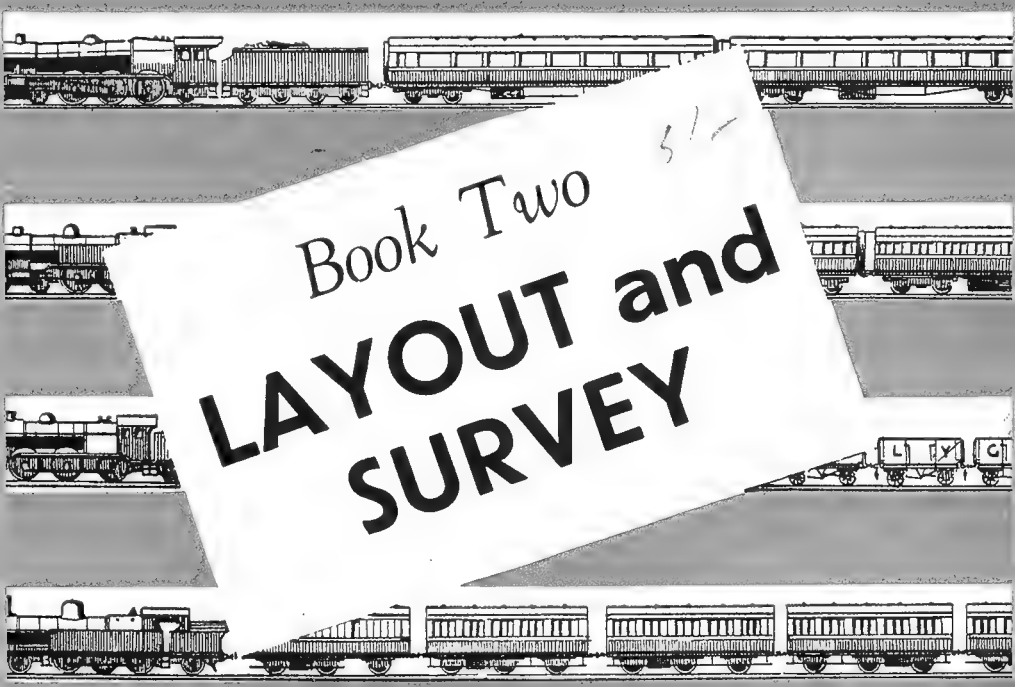

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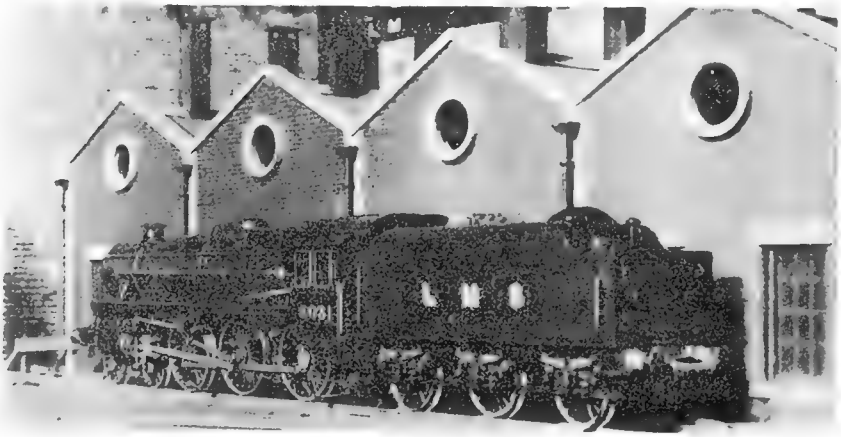
Track layout and miniature trains—whether real or model, a lovely sight to the enthusiast. *Photo by J. S. Wood*



A fine oo*-gauge Stanier at the sheds. Shed and locomotive by Mr. E. H. Whittaker*

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THE STANDARD DIMENSIONS

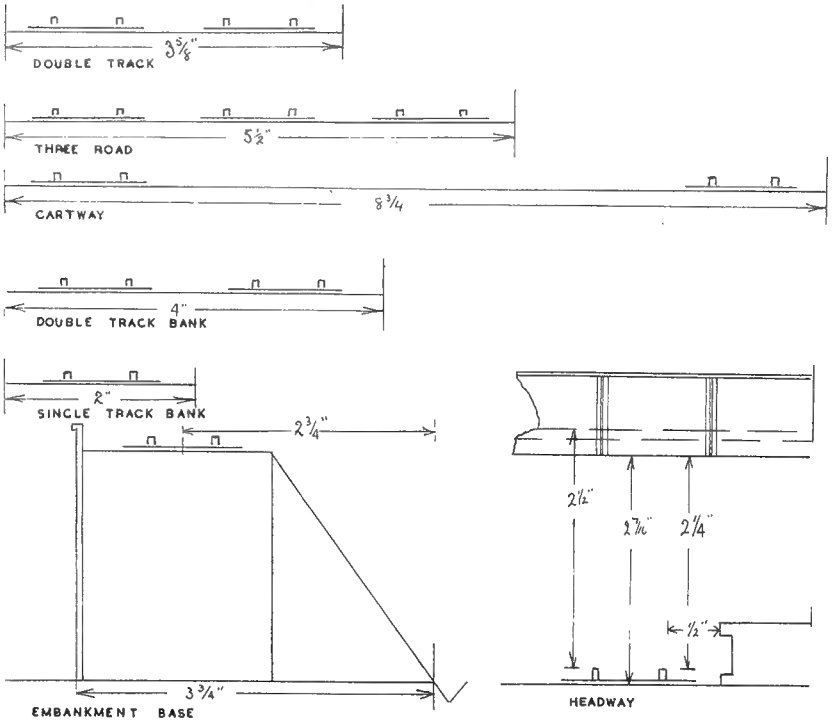
There was a day when no particular standards prevailed for the designing of miniature railway layouts, nor for the precise sizes of the wheels and the track sold by the various manufacturers. The result of this situation, as may well be imagined, was chaotic. But during the recent war years an opportunity was seized and an efficient task carried out when the British Railway Modelling Standards Bureau and, later, the Model Engineering Trades Association were formed. The example in this matter had previously been set by the Americans, who a considerable time earlier had founded their National Model Railroad Association. It became the purpose of these respective bodies to standardise the different dimensions applying to track, wheels, conductor rails and other items, so that there is now no confusion, and the manufacturers work to one method and one rule in all these matters. Happy indeed is the railway modeller in these circumstances !

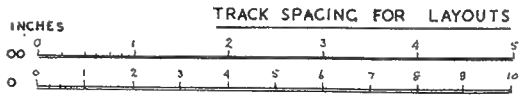
Each of these authorities publishes a detailed scheme of standards, and the beginner is advised to obtain this data forthwith—certainly not to proceed even to plan a layout without this invaluable and necessary guidance. It is unnecessary for me to outline here the standards in their detail. Let it suffice to say that the following is a list of the British Gauges and the American :—

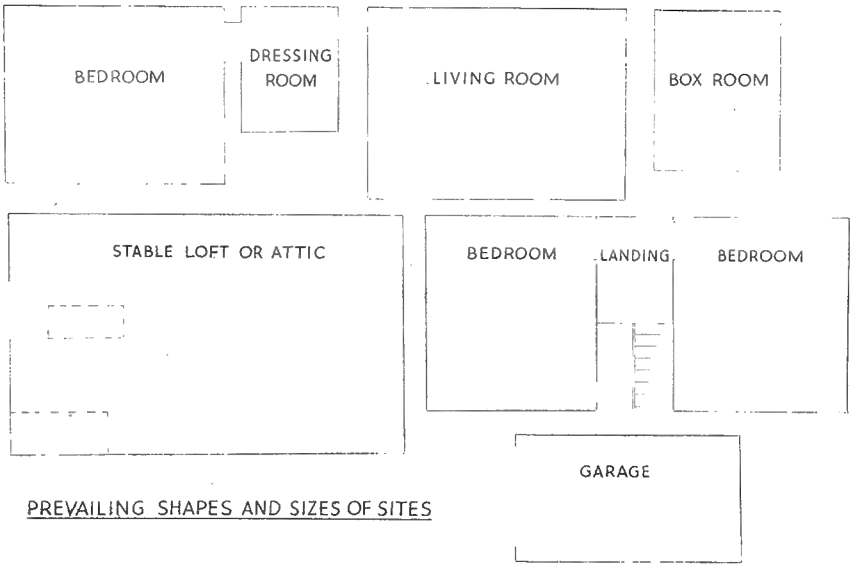
British :	No. 1 Gauge	10 mm. to 1 ft.; Gauge 45 mm.
	No. 0 Fine Standard . .	7 mm. to 1 ft.; Gauge 32 mm.
	No. 0 Coarse Standard	7 mm. to 1 ft.; Gauge 32 mm.
	No. 00 Scale	4 mm. to 1 ft.; Gauge 18 mm.
	No. 00 Standard . .	4 mm. to 1 ft.; Gauge 16.5 mm.
	No. H0 Scale	$3\frac{1}{2}$ mm. to 1 ft.; Gauge 16.5 mm.
American :	TT Gauge	$\frac{1}{10}$ in. to 1 ft.; Gauge $\frac{15}{32}$ in.
	E-Gauge	$\frac{1}{8}$ in. to 1 ft.; Gauge $\frac{19}{32}$ in.
	H0-Gauge	$3\frac{1}{2}$ mm. to 1 ft.; Gauge 16.5 mm.
	00-Gauge	4 mm. to 1 ft.; Gauge 19 mm.
	S-Gauge	$\frac{3}{16}$ in. to 1 ft.; Gauge $\frac{7}{8}$ in.
	Q-Gauge	$\frac{1}{4}$ in. to 1 ft.; Gauge $1\frac{3}{16}$ ins.
	0-Gauge	$\frac{1}{4}$ in. to 1 ft.; Gauge $1\frac{1}{4}$ ins.
	0-Gauge	$\frac{1}{64}$ in. to 1 ft.; Gauge $1\frac{1}{4}$ ins.

In all these instances the " Gauge " signifies the distance between the insides of the running rails. It will be obvious that in designing a layout, and calculating the distance of one set of metals from the next, the exact dimensions of the Gauge, rail width and " six-foot-way " (distance between each pair of rails) must be ascertained. Other clearances, equally important, will require to be known for application at bridges and tunnels. As for the overhead clearances, these should be obtained in blue-print form from any of the houses which deal in these commodities, the special scale to be adopted being indicated in the order.

For the special benefit of layout designers, however, I give a diagram (which must be accepted as purely informal) suggesting the working distances for the spacing of tracks in drawings, and these will require to be scaled by the draughtsman to suit the Gauge of his layout.







PREVAILING SHAPES AND SIZES OF SITES

PREVAILING SHAPES OF SITES

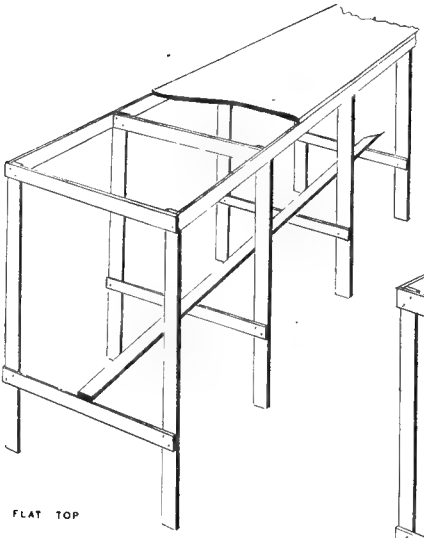
In layout designing, a vast amount of importance attaches to the type of room at the builder's disposal. It may be a spare or vacant room in a dwelling house, such as a reception-room or a bedroom, or a bedroom with a small old-style dressing-room adjoining (should the builder be so fortunate). Or, it may be a store- or box-room, failing anything better; or, still again, a garage, a reasonably commodious modern attic formed in a false-roof, or a loft over an ancient stable or coach-house. It is well to keep these possible shapes in mind in the task before us, for, when it comes to suggesting actual schemes, this can more or less readily be conceived to fit within these normal areas. I have therefore given a group of diagrams which cover most of these instances and, later in our discussion, designs will be provided as adaptable. Some margin of latitude will, of course, be left to local conditions. It follows, however, that a scheme to suit a garage will be unsuitable for a spare reception-room or a stable-loft; and in order to cover all requirements it seems a sound idea to know the shapes and forms we are working to.

THE LAYOUT SUB-STRUCTURE

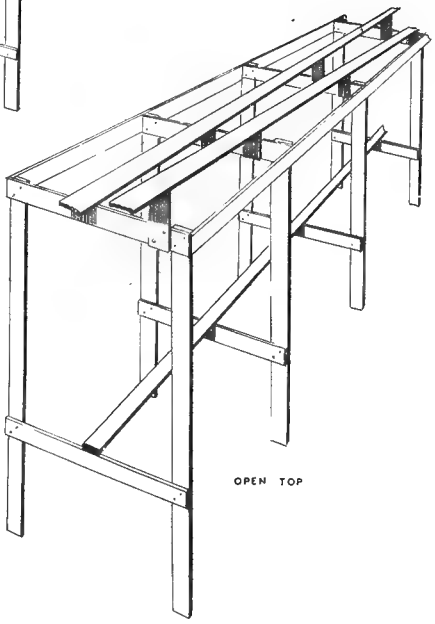
The first structure to consider with a layout in view is the baseboard on which it is to be erected. Innumerable ideas have been furnished by different writers for these, the majority of which have always impressed me as being too elaborate, too reckless of timber and too expensive. A factor to remember at the outset is that the walls of the room, if the baseboard is to abut upon these walls, will in themselves furnish most of the upholding support required. A table wedged with its back to a wall and its ends against other walls needs very little in the way of cross-members underneath it. While the structure should not be so light as to be flimsy or out of proportion to the weight it must bear, it certainly does not need to be heavy. Cross-members must be sufficient to hold in place the legs of the structure, and that is all.

A portable baseboard is quite different; and so is a supporting table for the centre of a room having access space all around it. In the former instance a special structure will be necessary; but in the latter instance there is certainly no need of diagonals between every pair of uprights. If the central table is built in sections, and if the longitudinal upper runners are securely bolted together, one or two diagonals here and there, especially at the corners, will be adequate.

Baseboards may take either the "flat-top" or the "open-top" style. That is to say, in the former case, the completed job may have a top like a table or may, if open, have no top whatever. For either method the underwork may be just the same. But if the open-top idea is followed there will be less need of timber than for the flat-top, since, if some form of pressed pulpwood is used for the top surface, it is imperative that this shall be well supported. For the softer pulpwood preparations it may be necessary to provide even additional longitudinal supports, for the material will take very little weight without in time beginning to sag. A wiser plan is to use the harder form of compressed wood, which retains its rigidity very much better. The two drawings on page 8 will indicate the essentials of the understructure, with the possible additional top supports for a soft surface. For the framework, use 2-in. by 1-in. planed timber, and if the erection is permanent the legs should be nailed down to the floor. Should the floor be uneven, a certain amount of judicious packing may be done under the legs as required.



FLAT TOP



OPEN TOP

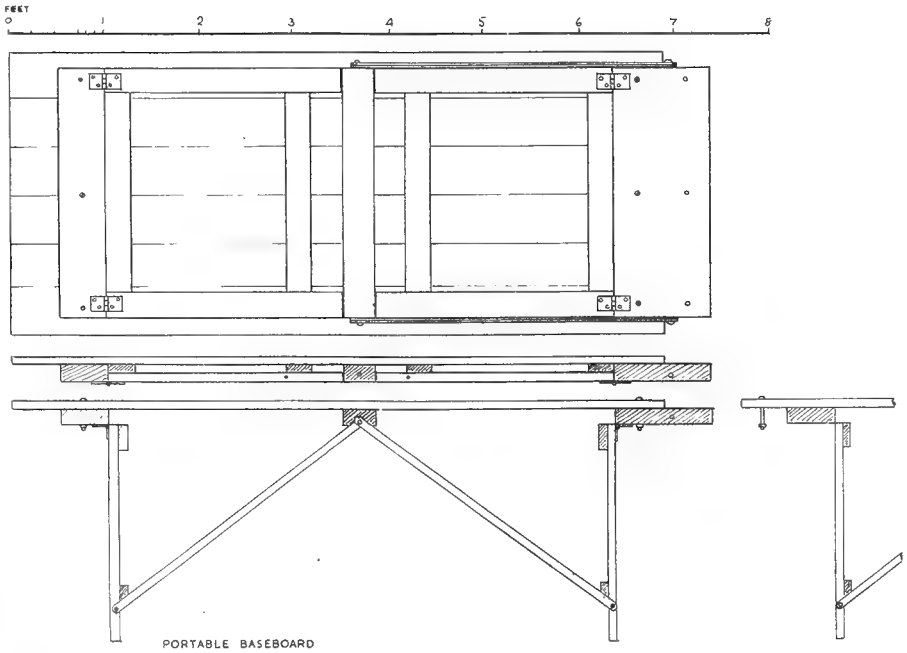
CONSTRUCTING BASEBOARDS

Among many claimants for superiority among the various pulpwoods obtainable in the good old days, I found " Tentest " boards the most acceptable, if only because of the variety of thickness and degrees of hardness available. A favourite of my own was a variety about $\frac{3}{4}$-in. thick, with a soft side and a hard side, the hard side being exceedingly hard. This was, of course, arranged underneath. This commodity, or others much like it, should again be available in due course.

The open-top table is by far the best if the line is to be a scenic one. With this system, the tracks are laid on light planking nailed to the cross-runners ; or, if the track is graded, the planking is nailed to supports which are screwed to the sides of the runners in the manner shown. For the main line, the intervening open spaces are duly filled in with scenic material. At station and yard sites, of course, the top is made flat.

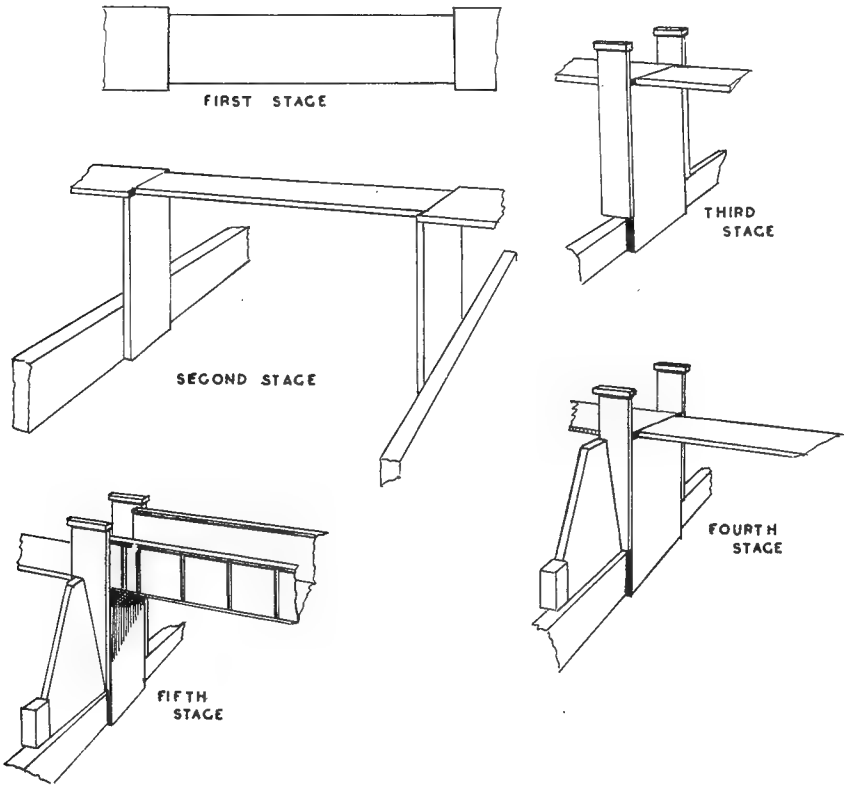
It follows that a portable baseboard will almost necessarily take the flat-top form, since otherwise its portability would be more or less imperilled by reason of the delicate scenic material filling up the cavities.

The best scheme I know for making trestles to suit a portable table is one which I have copied from my baker, who also happens to be a caterer and hires out these benches. The idea is shown in a diagram below.



PORTABLE BASEBOARD

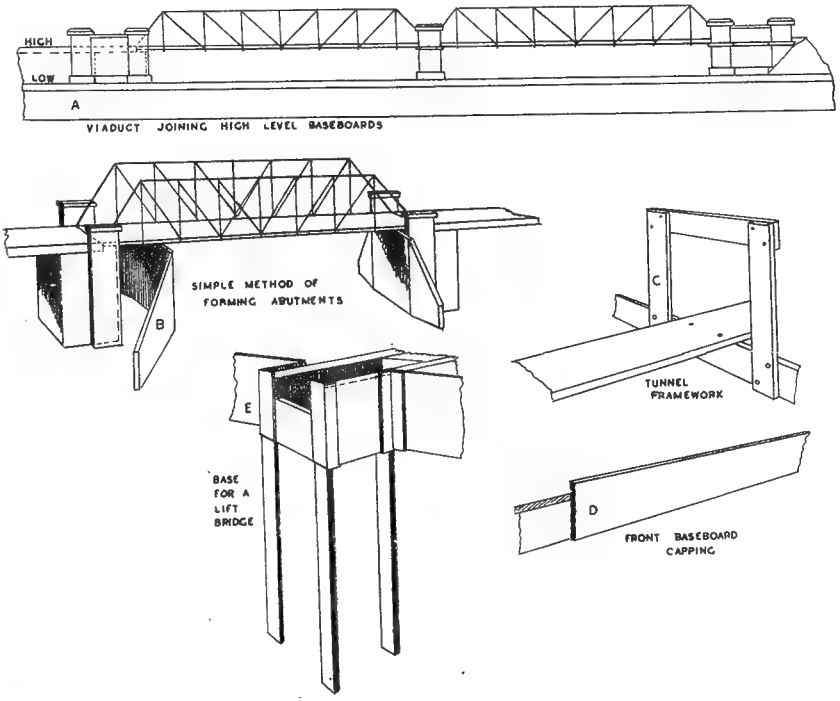
A great advantage of the open-top method is that of the simplicity with which sub-structures of bridges and tunnels can be installed. In a series of sketches overleaf I have shown one method by stages. The first stage shows the trackbed and the bridge deck for a small plate-girder bridge, the deck being slightly narrower than the trackbed. Stage 2 shows a pair of uprights forming the inside of the abutments, screwed to the sides of the table cross-runners. The third stage indicates that a pair of piers have been added at one end, and these are, of course, duplicated at the other end. Stage 4 shows the first wing-wall in place, the other three being identical, and in the fifth and final stage we have the girders fitted.



BRIDGE FOUNDATIONS ON OPEN TOP BASEBOARD

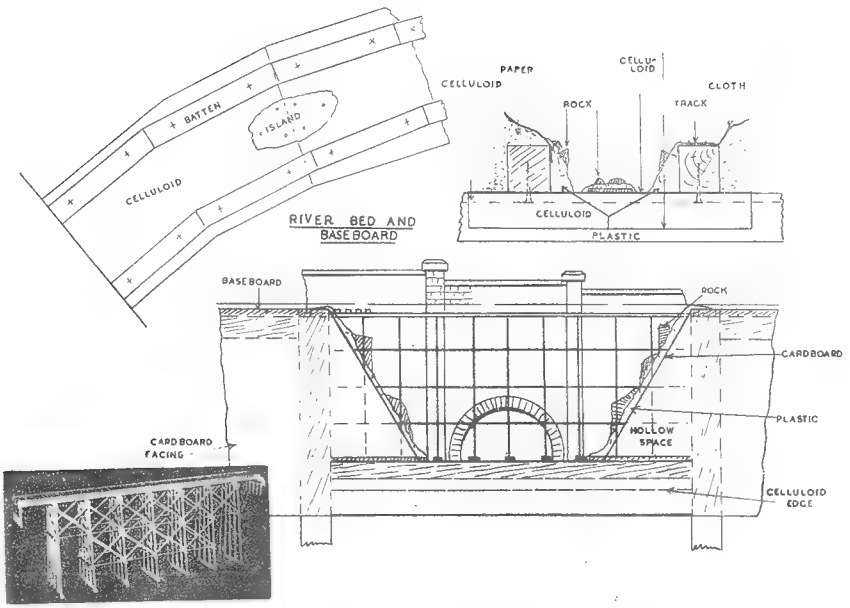
In the following drawings on page 11 two or three other bridge foundation ideas are explained. The upper drawing shows a two-span lattice viaduct on a flat-top base, erected on the lower level and joining up two sections of high level. In the next figure (B) there is a simple scheme for forming abutments to suit a lattice bridge of the short type, which may apply to either an open- or a flat-top base. The piers are fitted as before, and the wing-walls, each pair in one piece, are formed of stout cardboard which can be later treated with building paper or paint. These are simply slipped under the deck and pinned in place. A more formidable item in sub-structure work is that of (E) which gives a useful idea for supporting a rolling or pivoted lift-bridge, occurring as it often will at an angle with the baseboard front. The bridge supports are projected from the cross-

runners and cut to correct length, being afterwards supported by legs and a front casing. The latter may be finished to simulate brick or stone-work. In (C) we have the simple framework for a tunnel mouth, and in (D) the recognised method of fitting a front capping along the baseboard edge.



BRIDGES AND BASEBOARDS

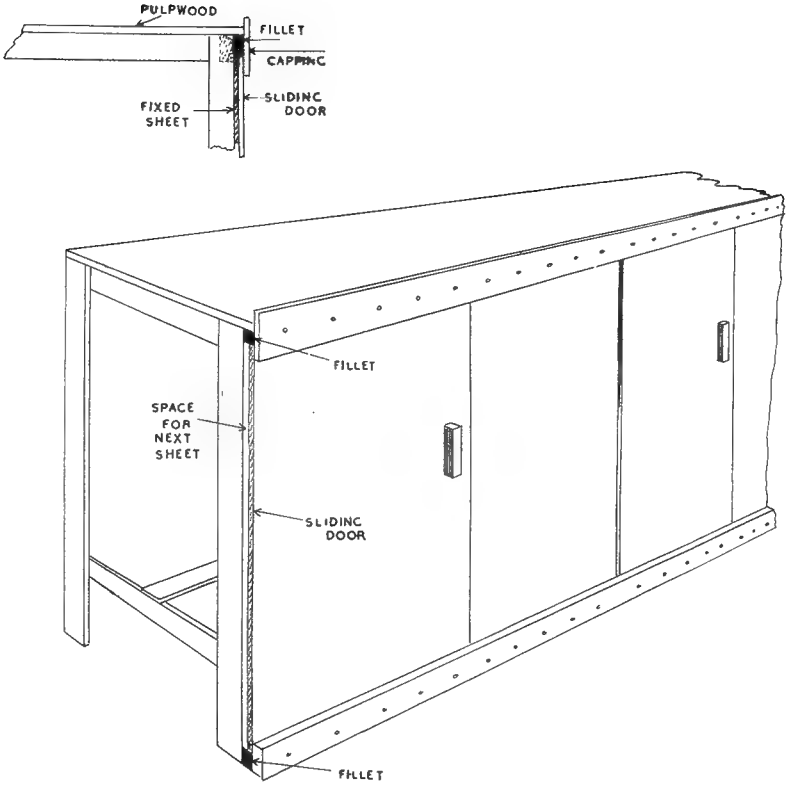
Something similar in sub-base work is required for rivers and streams. So far as this work concerns us at the moment, a helpful diagram or two will serve to suggest a method I have always followed myself. In the plan (top left) on page 12, it will be seen how short straight battens are attached to the baseboard (where such exists), and that beneath these battens there are sheets of celluloid. If joints occur in this material they are covered with a piece of plywood screwed down to form an island. In the sectional diagram to the right the details are clearer. It will be seen that the celluloid sheeting is bent over the front edge of the baseboard at an angle, and is fastened down behind the front capping. The actual embankment



BASEBOARD STRUCTURE FOR AMERICAN TRESTLE

surfacing, which rightly comes under the heading of scenic work, is formed of any recognised plastic material, into which there are glued pieces of actual rock taken from any garden or quarry. Where there is need of large areas of this work, it is advisable to use thin cloth or calico, or medical lint, stuffed underneath with crumpled paper and afterwards painted. In these days when it is hard to obtain celluloid, ordinary cellophane will serve.

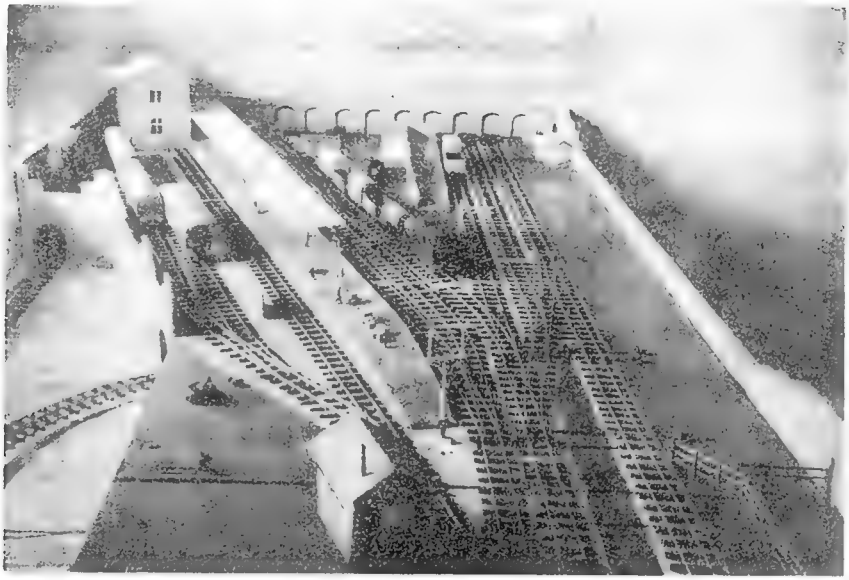
The lower diagram shows the same method applied to the instance of an American timber trestle, one of which is now installed on the writer's layout. The most difficult part of this work was found to be the placing of the cardboard embankment supports for the plastic. But these were finally done in a satisfactory manner piece by piece, the pieces being fastened together with adhesive paper tape. In this instance, the rear wall above the culvert was the abutment to a highway, and it was finished off in old stone building paper. The front capping, duly painted brown, gives an effective finish. The kits for these trestles are an American product and are most satisfactory.



BASEBOARD FRONT ENCLOSED WITH ESSEX BOARD

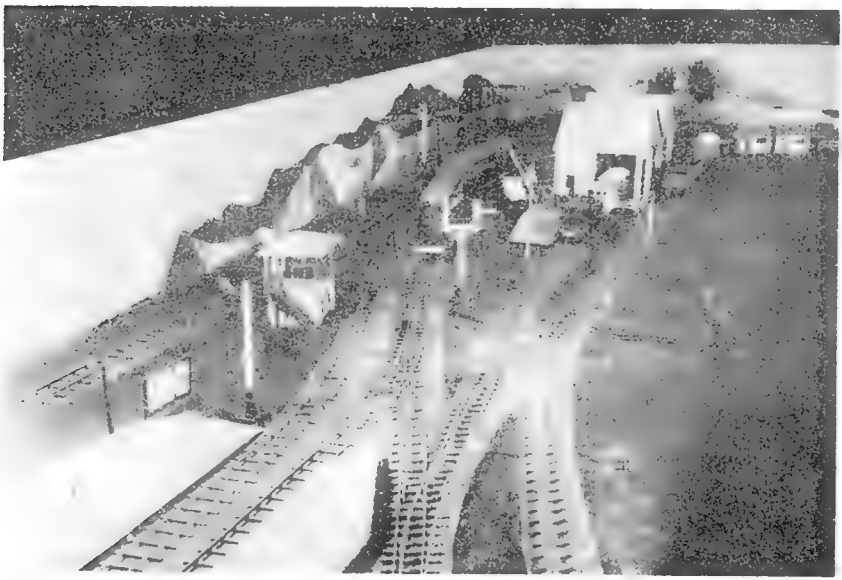
While discussing the subject of baseboards, it may be as well to deal with the question of the lower front below the railway. Sometimes this ugly aperture, which can effectively ruin the appearance of any line, is curtained off, or even left open. A better scheme is to enclose the whole of it with Essex board, which is reasonably cheap and can be obtained in small quantities. A good plan is to make some of the sheets capable of sliding in grooves, and an illustration makes this clear. The whole front is thus properly screened off, and under the baseboard there is an excellent place for storing the boxes in which the layout can be packed.

Much controversy has been waged around the question of the correct height of a baseboard above the floor ; but like many other heated questions this one is simply a matter for the taste and satisfaction of the owner. Something will depend upon the operator's height. I have found, being



TWO-RAIL TRACKWORK IN 00-GAUGE

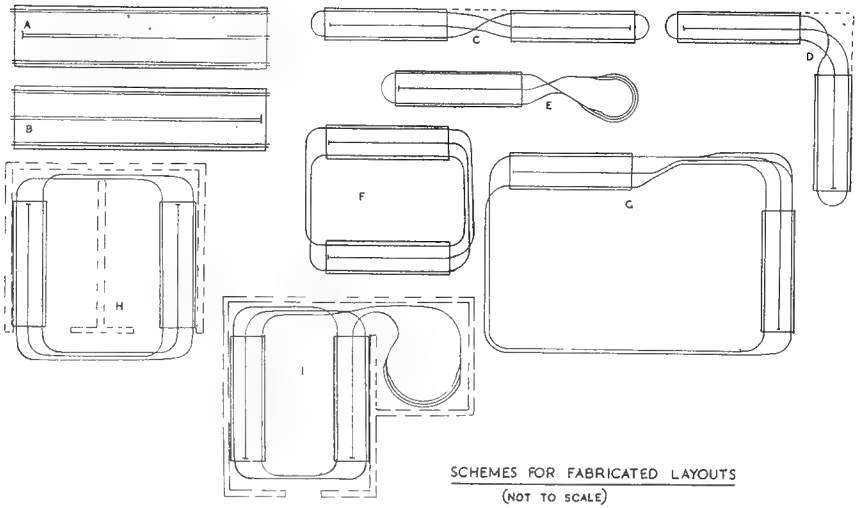
Mr. G. Atkinson's portable layouts Nos. 1 & 2



of medium stature, that 3 ft. is a good mean, with variations according to gradients and levels. Never build a layout on a floor, unless indeed the access spaces are sunk below its level; and if you build it higher than 3 ft. you will find that, although a better view is had of the models, there will be tantalizing troubles when repairs and maintenance are required.

When the allotted space has been measured up, and the various obstructions, such as doors and windows taken into consideration, it will have to be decided whether the layout is to occupy the space around the walls, with access in the centre, or the space in the middle of the room, with the access on the outside. Each of these alternatives has its merits and defects. If the railway is laid around the walls, you will get much longer straight sections of track, and the convenience of reaching all parts of the layout is much greater. It is no disadvantage that a visitor will have to turn around often to see the operations, for this will give the impression of a larger system. Along the walls there is more room for trackage than in the room centre, and the walls themselves form both a good support for the baseboard and a fine scenic finish if properly treated. On the other hand, if the middle is chosen, it is much easier to make the layout portable, it will be unnecessary to reach over awkward spaces to clean, and manipulate the opening and shutting of windows, there will be less trouble at doorways, and the wiring of the system will be easier. It must not be forgotten that if space is reasonably plentiful, both systems can be combined to a large extent. It is certainly an error to build a layout to the neglect of a large open space in the middle of the room. The aim should rather be to use all the space there is for the railway itself, being mindful to leave just enough comfortable space for access and observation.

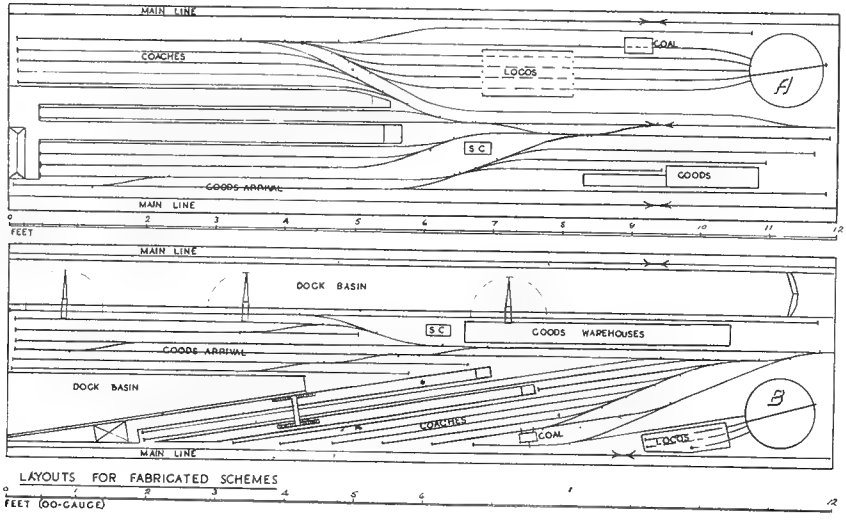
It is a conviction of my own that there is some future for the idea of a fabricated layout—by which is meant a layout that is both portable and adaptable to all manner of different sites, and which, consisting of two or more completed scenic sections, can be set up in different places and connected up with differing types of main line routings. The main line for this purpose may be either in finished sections of a more or less standard size, or may be of a less permanent nature. In the diagrams for schemes of fabricated layouts I have given a number of different alternatives, using the same pair of terminus blocks. These are marked A and B, and their baseboards are exactly alike. In C, we have the simplest arrangement—the two directly coupled up in one room, and occupying only one side of it. In D, we are using two sides of a smaller room with a different connecting arrangement. In E, only one section has been brought into use, being connected up by a series of loops, some of which have waiting and passing tracks. F is a larger scheme for opposite side walls and much better



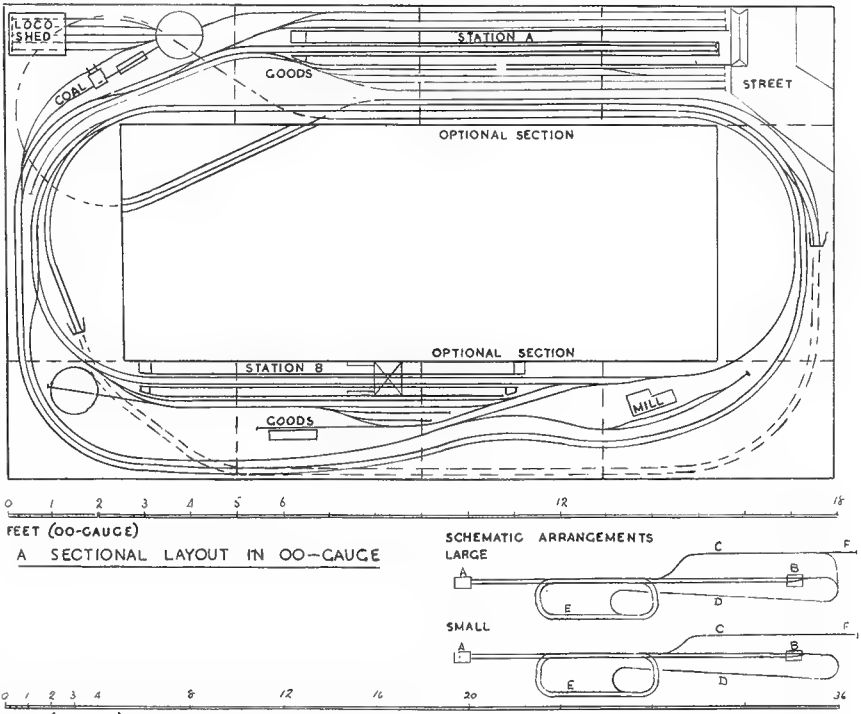
SCHEMES FOR FABRICATED LAYOUTS
(NOT TO SCALE)

SCHEMES FOR FABRICATED LAYOUTS *(not to scale)*

operating. G is the same pair of depots fitted up in a loft or small hall, and here the running possibilities are very extensive. In H, we have two small rooms in requisition and the adjoining passageway is brought into use. In I, the site is a small bedroom with adjoining dressing-room, the latter being used to accommodate reverse-loops and sidings.



LAYOUTS FOR FABRICATED SCHEMES



There is no objection, of course, to the entire outfit being made to permanent specifications, since the connecting sections would be almost entirely flat, and would take up little storing space and involve little expenditure. For those interested, I have included typical layout schemes for the two termini, one of which can accommodate even a small dock.

Yet another scheme, which has already gained some degree of acceptance, is that of the extensible system, or, to give it another name, the sectional plan. Here, the method followed is that of the ordinary portable layout in sections, one pair of these sections being so fitted with trackage as to be optional—they can be included or excluded at will. That is to say, the layout can be completely built, and may be used in different places ; or again, only the smaller representation of it can be built, and the remaining sections added later. In the plan I have given, it has been possible to include a reverse-loop, which gives excellent running facilities. The alternative running schemes are shown in the schematic diagrams. It might be useful to outline the possible runs, as something of a revelation of what is possible in a small compass.

For the larger scheme, the following are possible :—

From Station A via E to Station B ;
From Station B via E to Station A ;
From Station A via E, C, D, E to Station A ;
From Station A via E, C to F ;
From Station B via D, E to Station A ;
From Station A via E, B, D, E to Station A ;
From F (rev.) via D, E to Station A ;
From F via C (rev.) and E to Station B ;
From Station B via D, E, A (rev.) E, C to F ;
From F via C (rev.) and E to Station B.

With the smaller scheme the following would be the routings :—

From Station A via E to Station B ;
From Station B via D, E to Station A ;
From Station A via E, B, D, E to Station A ;
From Station A via E, C to F ;
From F via C (rev.) and E to Station A ;
From F via C (rev.) and E to Station B ;
From Station B via D, E, A (rev.) and E, C to F.

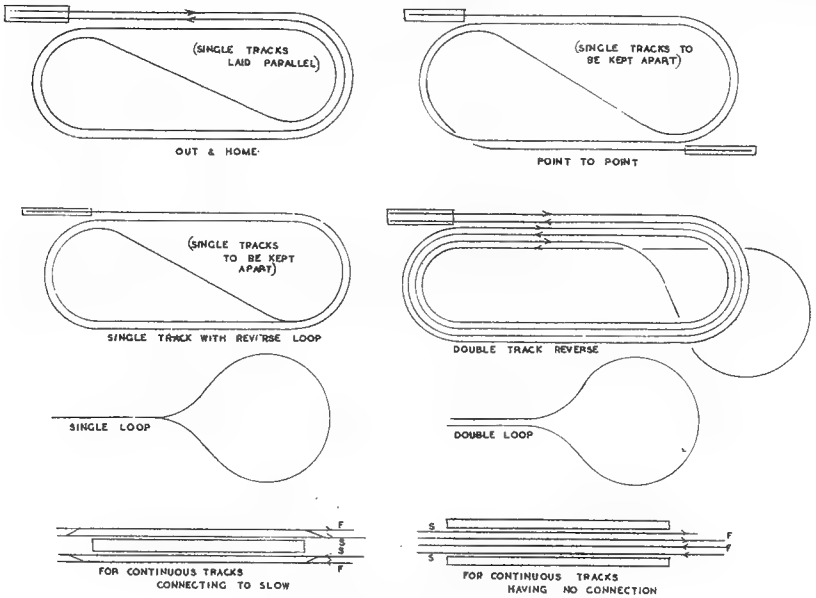
The radical difference in the two layouts, of course, is merely caused by the insertion (in the larger one) of the short link in the lower optional section. This forms a connection between F and D, making several circular runs practicable.

This example is given in order to illustrate the possibilities of the sectional-extensible layout idea ; it can be applied to all manner of layouts, so long as the connections at the optional parts are identical in the way they fall, and are so arranged as to suit either the one layout or the other. Further advantages of the larger arrangement in this case are to be found in the increased lengths of both stations—a most important factor.

There is likely to be some need of care and forethought, in layout planning, to meet the exigencies resultant upon the occurrence of doorways into the room. Generally speaking, these troubles are not serious. It is good to design your scheme so as to avoid more than one interruption in the access space, though at times this is an advantage not to be secured. To span the gap at a doorway the best expedient is the lift-bridge or the swing-bridge, the former being preferable owing to its complete clearing of the passage-way when open. Here is an opportunity for the installation of a spectacular engineering feature, a baseboard groundwork for which has already been given.

TYPES OF MAIN LINE FORMATION

It will be familiar knowledge to all who have read to any extent the literature of railway modelling that there are certain recognised forms of layout arrangement that are possible within the restrictions of average indoor space. These include the " out-and-home " idea, by which a train may run out of a large terminus, over a lengthy main line, and back in again, and the " point-to-point " scheme, whereby the journey is out of one terminus, over the main line, to a second one. A further innovation long since devised in order to extend the period of time taken by running is that of the " continuous run." By this means, through the intervention of some form of link in the cycle of tracks, the trains traverse one portion of the main line as many times over as desired before being switched into the tracks of the arriving station. A further aid is the " reverse-loop " which is often placed near what would otherwise be the extremities of a main line, connection being thus made for a return journey over the same metals. There are also certain possible combinations of these two schemes.

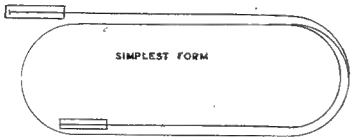


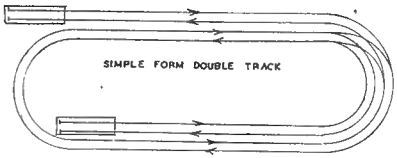
MAIN LINE SCHEMES

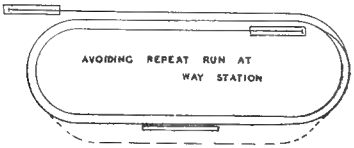
In the first diagrams on page 19 of main line schemes a number of these notions are expounded. Thus we have (top left) a simple out-and-home arrangement in which, because the trains will always be travelling in the correct " up " and " down " directions, the single track can be laid as double track at certain places. In the point-to-point diagram opposite this, the single tracks must be kept separated by a low embankment where they would parallel each other, since the running will not always be akin to that of " up " and " down " tracks. The single track with reverse loop plan has a similar requirement, but there is no such stigma attaching to the double track layout alongside it. This fourth plan, extended to fill out a spacious apartment, would have excellent possibilities. It should be observed that single loops and double loops for reverse purposes are tricky and interesting things, and an example of each is given. Observe that a double-track loop does not require double tracks ; it is merely a single track connecting the ends of double track. If the lines were doubled, by means of a double junction and scissors crossing, nothing whatever would be secured that is not already secured by the single track. When loops are introduced, deliberately as such, it is advisable if possible to conceal them for the sake of effect in operating. This can be done by running them below the upper baseboard level, or by tunnelling them over or taking them behind a backscreen.

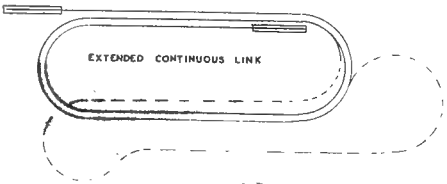
A common expedient for securing repetition of runs within a restricted area is that of laying the tracks in quadruple form. The only disadvantage of this practice is that actually the same terrain is traversed each time the trains take a different lap of the route. There are occasions, however, when this cannot be avoided through lack of space, and in order to avoid actually touching at the same stations while running on different laps there are several courses from which to choose. One is to lead off one pair of tracks where the station occurs. A better method is to employ the " four-track " running system as it is in vogue on the Southern Railway and the Great Western. The " up-and-down-pairs " system is the more commonly used style, and the value of this arrangement on a model layout is shown in the two diagrams descriptive of main line schemes—the plan with island station and fast tracks, and the plan with inside fast lines at the way station. Here it will be seen that although the rails of the " fast " lines pass the station, they are independent of it—and this is a most useful resource with quadruple tracks laid together through lack of space.

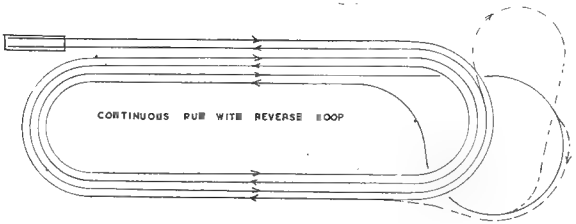
In American railway practice, and indeed that of other countries, the spiral ascent is employed on a considerable scale for climbing gradients in a compressed area. There is no reason why it should not find greater use on model layouts. Here, again, the somewhat unsightly circle of



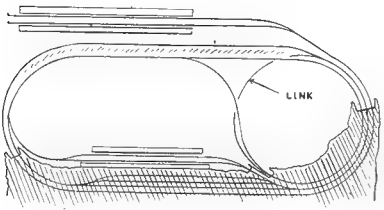




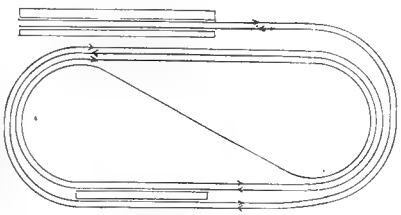




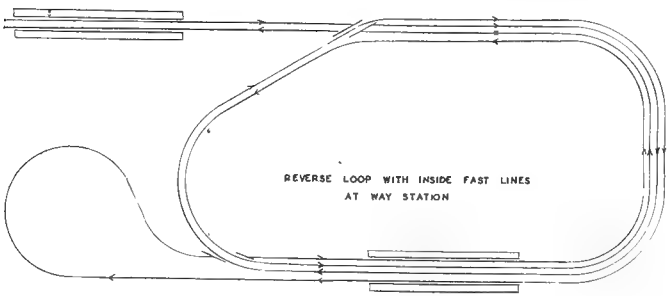
CONTINUOUS RUNS AND MAIN LINE SCHEMES



CONTINUOUS RUN WITH REVERSE LOOP



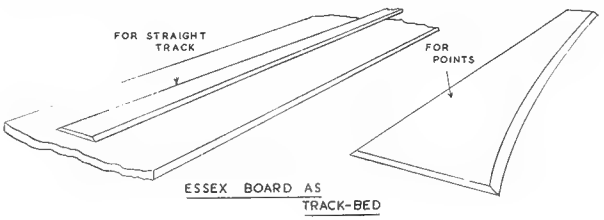
REVERSE RUN WITH
ISLAND STATION AND FAST TRACKS



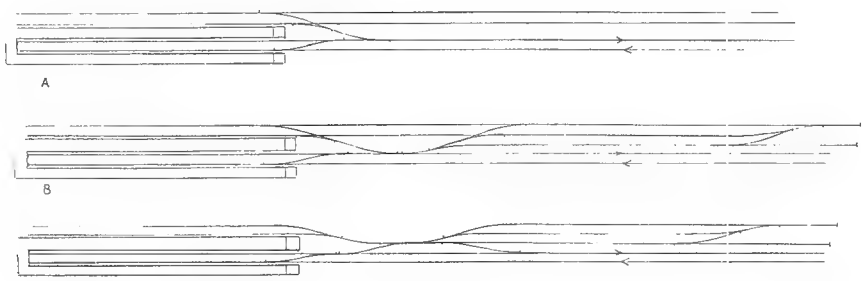
track can easily be concealed and the tunnelled entrances can be made very attractive and picturesque. Gradients are often a serious problem where space is limited, and the model designer has here a means for overcoming the difficulty away in some obscure corner or beneath a baseboard.

PRINCIPAL CONDITIONS TO SECURE

Probably the first thing to aim at in track designing is the securing of an adequate and realistic length for station sites. It is only very recently that any serious regard has been given to this matter by writers on the subject, and one smiles to see former efforts at station planning with platforms about 3-ft. in length for 0-Gauge. Certainly such layouts could never be operated. It is better to have one or perhaps two stations in a scheme, and for these to be large enough to accommodate any kind of desired traffic correctly, than to have numerous unsatisfactory halts at which every rule of traffic control requires to be broken. Indeed, there is really no scope on any indoor model of the normal dimensions for a station or terminus having more than four platform tracks ; and two or three will be found even more workable. But what is sacrificed in width should be made up in length, for length will be in demand. Principally, this need emerges with coach handling ; but it is almost as great in relation to the



ESSEX BOARD AS TRACK-BED



COACH STORAGE AND LENGTH OF STATIONS

arrival, shunting and handling of goods trains. On the subject of coach storage and length of stations a diagram is given in series form. In A, we have a pair of station platforms with arrival and departure tracks and some sidings rather arbitrarily placed. You are to imagine a train arriving at the lower track and coming to a standstill. What is to be done with it next? It could be drawn out by a shunting engine and, using the departure track to the right, could be pushed into the departure platform track. But this is just what must not be done, for the main line will be fouled by the operation. Yet it is exactly what is done on 90 per cent. of the layouts in existence. A better method of handling is shown in B, where the train can be hauled back into any of the upper right-hand tracks, and can there wait its turn until more urgent traffic is attended to, afterwards being run into its place. But as the tracks stand, this arrangement has involved extravagant trackage—two single slips and some feet of straight being wasted. In C, the same provision is made, using all tracks for their due purposes and permitting every kind of movement required, while saving three points and two diamond crossings.

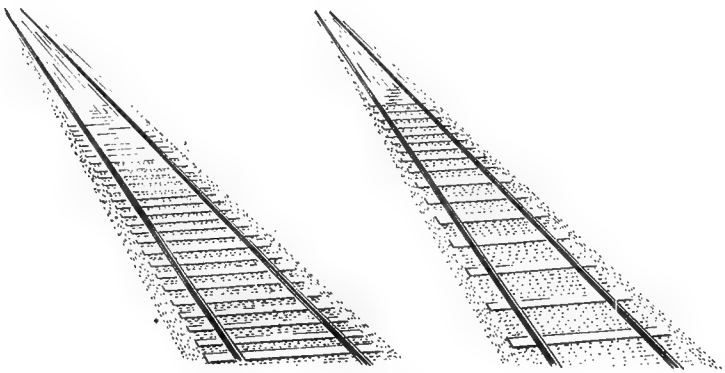
Observe, however, that in thus providing for a workable scheme, we have occupied a total length of 16 ft., allowing for platforms 7 ft. long. This is rather liberal; the same arrangement can be carried out for five-coach trains in a length of about 13 ft. The diagrams are not to scale. If it is desired to work trains correctly in this way, the station will require 13 ft. in length. In certain instances it may be possible to abbreviate this distance by placing the storage fan of tracks to the left instead of to the right; but a draw-out road will still be needed, though this can sometimes be run out alongside the main line.

Upon the subject of long main line runs I have already dwelt. It is all very well to discount the importance of this item while anxious to lay down a satisfactory station for operating purposes. But let me assure you that the "length of life" of your layout—the period of time it will serve to interest rather than to bore you—depends very largely indeed upon how long and how varied the main line is. Nor is length of run the difficult problem it is often thought to be; much can be done by careful forethought and fitting the tracks into the space, even in the smallest room.

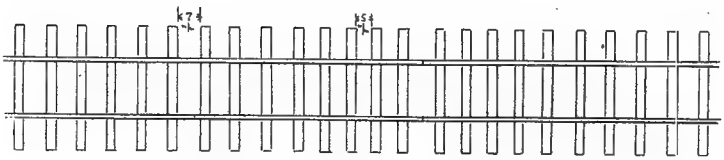
Next, watch your curve-radii, if you are a beginner. There is, on the one side, a temptation to make curves too sharp in order to secure straights, and on the other side to be too liberal in the radius to allow for long vehicles. There is really no set rule. All depends on the sort of locomotives and stock you wish to run. It will be found that 2 ft. is about the minimum for standard engines of the six-coupled kind, as well as for

bogie coaches. That is, of course, for 00-Gauge. For 0-Gauge you will need more than twice that radius.

Finally, there is the matter of track-laying itself. It is a sound course to make up your mind to lay your rails perfectly, on a thoroughly sweet and level trackbed. An excellent medium for the latter purpose is Essex board cut in strips to represent ballast, with the edges chamfered at an angle, the whole painted, and strips of brown-dyed baize supervened between track and bed for silent running. The Essex board should at points and crossings be shaped according to the requirements, as indicated in the drawing. The subject of sleepers is also one which will repay more than usual thought. In a sketch I have tried to show how much better a track appears with correctly spaced sleepers ; but until the post-war days I never saw track sold commercially that had the proper sleeper spacing. It should be noticed that the gaps between the sleepers vary towards the end of each pair of rails, near where the fishplate occurs, the spacing here being slightly closer.

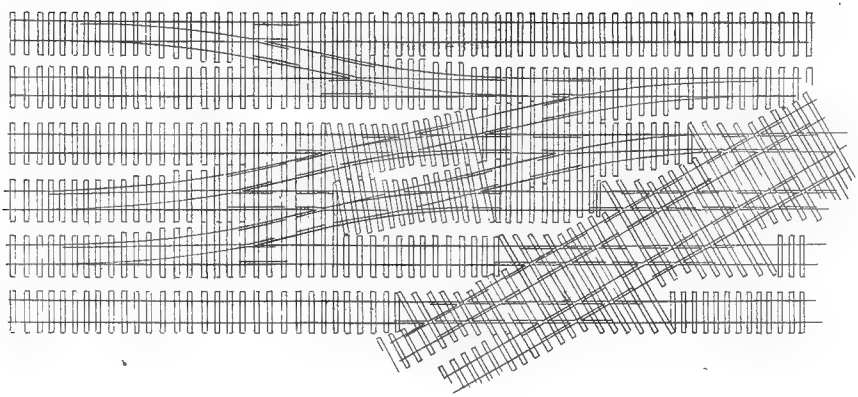


EFFECT OF CLOSE AND WIDE SLEEPERS



CORRECT SPACING OF SLEEPERS *(00-Gauge)*

The actual placing of the sleepers in model work is a very tough problem to face. As a matter of fact, it is not possible at an extremely complicated location to emulate real procedure in this respect. In the

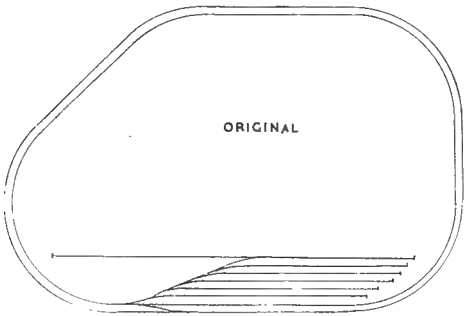


SLEEPERS AT COMPLICATED CROSSINGS

diagram I have made of such a network, rather extravagant in conception, the true practice would be to shift and vary the angles of the sleepers for the double crossings to an enormously greater extent, practically no adjacent two being the same, and thus to secure the necessary angle for the fixing of the chairs. If I were myself faced with such a similar situation on a layout I would follow something like the course I have indicated; and where ordinary chairing could not be executed I would use a touch of solder, utilising the metal chair base if the sleepers were of wood. An important snag to watch is that no one rail shall anywhere have a section of sleeper to itself; every sleeper must support a pair of rails or more than a pair. Otherwise the appearance would be much more incorrect than it is already. Where such complicated sections of points are obtained commercially, the builders can usually be trusted to make a quite respectable finish. But if the amateur builds up his own there will be need for very judicious arrangement.

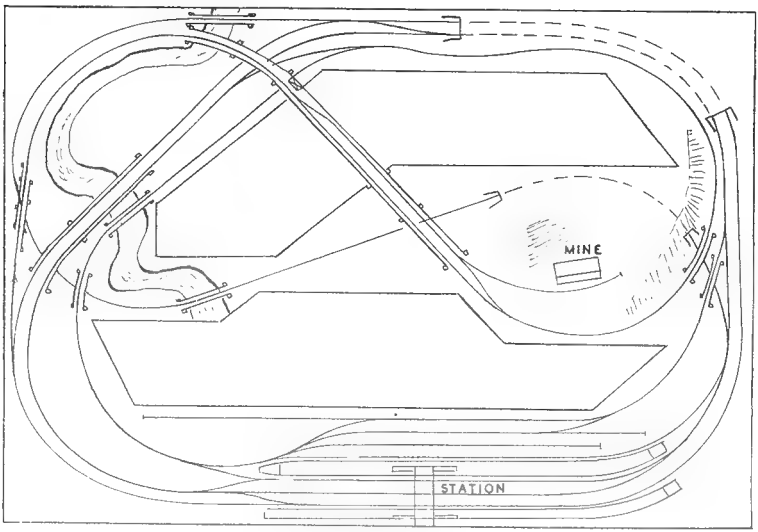
ERRORS PROBABLE WITH EARLY DESIGNING

In his first attempts at layout design, the amateur is liable to fall into certain quite familiar errors against which he can be warned. In the first place, he will possibly follow the usual course of imagining that he is planning for all time, and will insist in his own mind that his layout shall be so perfect as to need no subsequent adjustment or alteration. There is no such ideal layout. And it may be stated that the pleasure of re-design is much more thrilling and remunerative than original work. The best



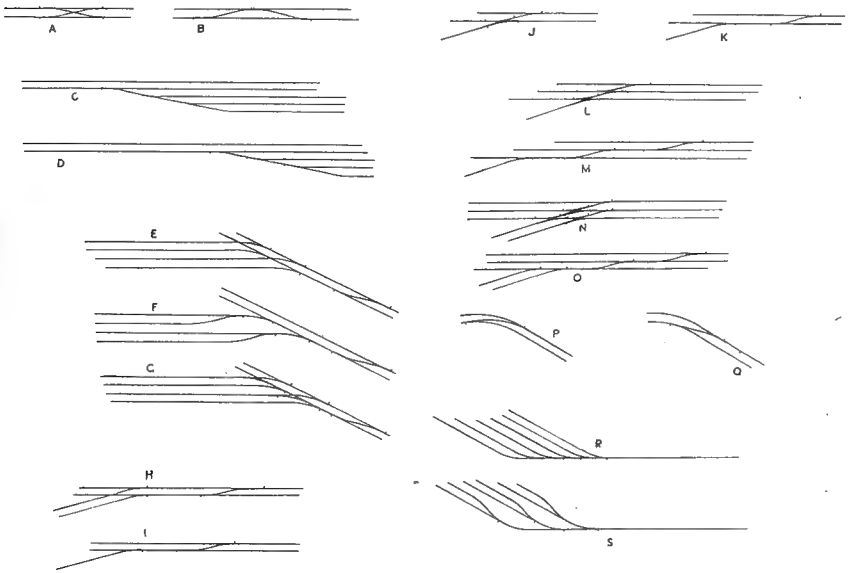
POSSIBILITIES OF EXTENSION AND DEVELOPMENT

(An inadequate scheme improved)



layouts are always the improved and extended ones—and that is reasonable enough, for we only find out our mistakes by making them. An ideal scheme is the work of years, much the same as an ideal life is. As a simple example of a re-planned system, I give a design by Linn H. Westcott, along with the original plan from which it developed. And if the reader wants further evidence of the truth of this contention, let him again examine the layout of Captain Shawe, described earlier in this series. Do not waste years, then, on mere paper experiment; get the materials as soon as you can, and start building, always provided that you are working to a real plan.

And here is yet another theme upon which not nearly enough has been written. Endeavour to avoid careless, extravagant and reckless planning. An example of this sort of thing is seen in the matter of the double-track loop I have mentioned. Having once fallen into this very trap myself, I can afford to forewarn others. But, lest I should seem to be merely writing, I have given a full page of diagrams indicative of the wastefulness of thoughtless track design. Thus, in A, you can save a crossing and a vast amount of wiring and running complication by substituting two crossovers B for a scissors crossing. Again, goods sidings at country stations need not be at all lengthy; they are often found as short as the length of one vehicle. So, you save space and rail by planning like D



UNECONOMICAL PLANNING

rather than like C. If you use F instead of E you will once more save two crossings, and crossings are problematic. But if you substitute F tor G, you save four points also. I, if practicable, gives you back a point and crossing from H. Double and single slips are invaluable on certain occasions; but there are times when they are a complete delusion. For one thing, they are the most useful and the most difficult of all track arrangements, both to wire up and to run trains over. Therefore, use K instead of J, and save a crossing and two points in so doing, unless for the sole reason of space. Notice that M saves you four points and two crossings from the wreckage of L, but also that if you go on to use N in place of O, while it may be necessary, you are eating upon no less than eight points and three crossings that you could save. An example of clumsy rather than extravagant work is seen in P, where a curved point is used. These are dreadful things; always follow the course shown in Q. And, if conditions allow it, you can make much prettier sidings by adopting the method of S and rejecting R—though this is not always practicable.

There are several other little dangers to the novice. One is that of over-complicated trackwork which looks very imposing but will give endless care. Another is the danger of overcrowding the various impedimenta of a layout until it assumes the appearance of a dog's breakfast rather than a railway running through an open terrain requiring transport facilities. It is good to avoid too many visible tracks; do not be afraid to conceal some of your permanent way, taking your trains off and bringing them on again to the stage at all manner of unexpected and interesting places. This concealing of certain tracks is also a sound economy hint, for where the metals run off the visible plane you need not use elaborately chaired rail, but may substitute one of the cheaper non-chaired forms. Reserve your chaired track for the places where it will be seen; but make your unseen track even more accurately than the roads that will be visible and accessible.

STANDING ORDERS AND REGULATIONS

We come now to the rules and standards laid down by the Government and by the railway companies themselves in accordance with which all planning and surveying are carried out. It is unnecessary to labour the point that these rules, within their practicable limits, are as authoritative for the layout designer as are the principles of actual construction for the locomotive builder. In the first place, there are the requirements laid down by the Ministry of Transport. A copy of these bye-laws may be had for 3/- from H.M. Stationery Office, Kingsway, London, W.C.2., and it is fully worth while obtaining one. Not only so, but it is even desirable that such items as locking bars (in dummy form if necessary) and safety points should be installed on a layout in order to provide the convincing atmosphere of realism and correctness. These are stipulated as essential by the Ministry. Facing points must be avoided wherever possible; sidings must be so arranged that shunting operations upon them shall cause the least possible obstruction to passenger lines. Safety points must be provided on goods sidings at their junction with main lines. Normally, the points of these are closed against the passenger lines and interlocked with the signals. Tracks at stations must be so planned as to avoid the possibility of trains standing on junctions at platforms. At terminal stations, a double line must never end in a single line. Platforms at small halts must not be less than 6 ft. in width, and at larger stations the minimum is 12 ft., and there must be a descending ramp at the open ends. There must be 6 ft. clearance between the platform edge and any pillars upon the platform. All signal cabins must have a full view of the signals they operate. Stations are not to be constructed on gradients, unless unavoidable. Turntables must allow ample clearance at their extremities, so as not to risk the fouling of other tracks. There must be a clearance of 2 ft. 4 ins. for all standing work between or adjacent to tracks; and every highway crossing of the railway must be protected with gates. There are other important regulations attaching to signalling and building construction, and these, though not within our immediate purview, should duly be studied.

There are certain other Government Standing Orders pertaining to railways which come into force in all layout design. There are grade limits for public roads that are reconstructed to meet the convenience of railways. The permitted gradient of these roads will be found to contrast very severely with that of many such highways in miniature layouts!

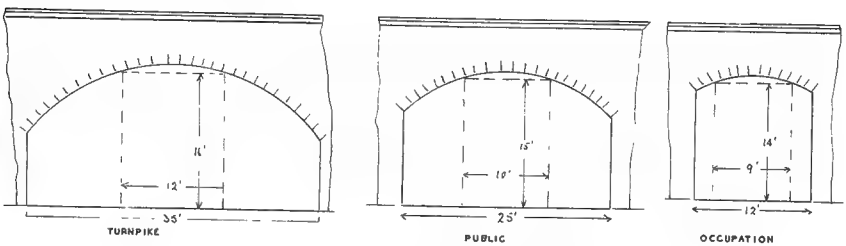
The average angle is about 1 in 24. Every bridge must be provided with a highway fence at least 4 ft. high on the bridge and 3 ft. high on the approaches. A bridge over a public road (turnpike) must have a clear span of 35 ft., with a headway of 16 ft. for a width of 12 ft.; or a span of 25 ft. with a headway of 15 ft. for a width of 10 ft.; or, if it be a private road, a span of 12 ft. with a headway of 14 ft. for a width of 9 ft. A drawing makes this clear. Road bridges over a railway must have the same width between the parapets as the widths required under the railway—35 ft. for a turnpike, 25 ft. for a public, and 12 ft. for a private road. All railway tracks must be fenced.

There are also various rules of procedure in regard to the layout of goods and passenger stations, which have passed into general usage and have become standardised for sound practice. A goods depot must be easy of access by rail and by road.

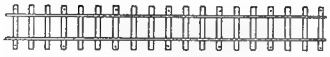
In the aerial photograph of Fareham Station there is afforded a most excellent idea of these approaches—one to the goods yard itself and a second on the other track to the cattle dock sand sidings—and the form they should take. The whole of the passenger

facilities are also very clearly shown. The rail tracks should permit easy access to the shed of the goods yard, and the yard storage tracks should be so kept separate from the shed tracks as to make congestion impossible. Sidings are usually placed on a slightly falling gradient from the main lines, chiefly as a safety measure. Yard sidings are usually in pairs, with a roadway between each pair, though this is a somewhat large order on a restricted model. Stationary jib cranes are exceedingly common, almost every country station being thus provided, but they are out-of-date. A most important item at any considerable goods yard is that there shall be a loop track alongside the goods reception track, joined by a crossover at each end, in order that arriving engines can be detached and get out of the way of the operations of the shunting engine. An extension to this arrival track, in the form of a spur, is a great advantage to facilitate shunting.

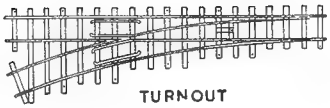
Some of the accepted rules of layout for passenger stations are as follows: Direct main line access for all incoming and outgoing trains; tracks for shunting and removing coaches without fouling main line; locomotive turntable as near as possible to main line, involving the minimum of movement; locomotive facilities such as coaling plants, as far as possible from passenger platforms by reason of dust and dirt; adequate street approaches either from high level, low level or track level. In model practice these may sometimes be arranged scenically " off-stage." The arrangement of stations often falls in such a manner as to exclude any other possibility.



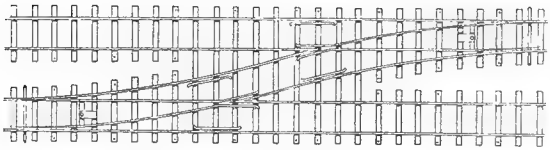
BRIDGE CLEARANCES



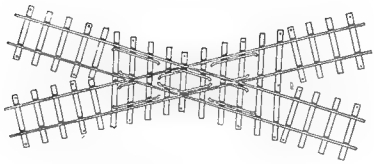
PLAIN STRAIGHT



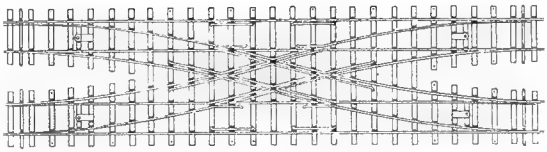
TURNOUT



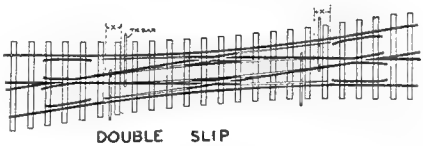
TRAILING CROSSOVER



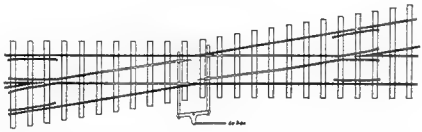
CROSSING



SCISSORS CROSSING



DOUBLE SLIP



SWITCH DIAMOND

MODEL POINTS AND CROSSINGS

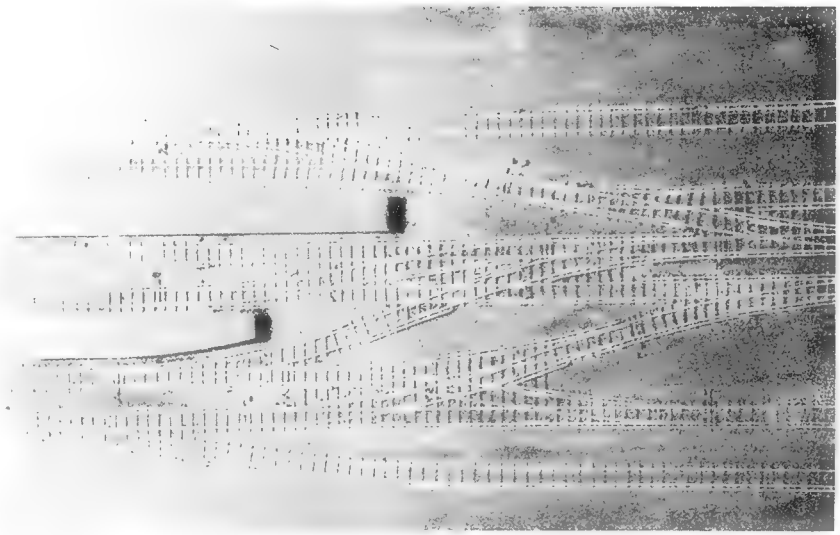
TABLE OF POINT AND CROSSING LENGTHS		
	00-GAUGE	0-GAUGE
Common turnout ...	10 ins.	18 ins.
Crossover	18 ins.	32 ins.
Acute Angle Crossing ...	11 ins.	19 ins.
Scissors Crossing ...	18 ins.	32 ins.
Single or Double Slip ...	12 ins.	20 ins.
Flat Diamond Crossing ...	12 ins.	20 ins.
Double Junction ...	16 ins.	28 ins.
	All 3-ft. Radius	All 6-ft. Radius

POINT DESIGN FOR MODEL WORK

Before proceeding to the actual detail work of layout, something must be said concerning points and their use. A series of diagrams sets forth the more common types—a length of straight track as commercially obtainable, a common turnout, a crossover, a diamond crossing, a scissors crossing, a double slip and a switch diamond. The last-mentioned is the newest feature of pointwork in the model sphere, and it has some very useful qualities. It will be observed that the actual diamond is movable, and is operated by a point lever or other means so that the gaps in the trackway, which often prove troublesome in model layouts, are closed, and a straight-through solid run is secured. I also give a table of the approximate length of the different points as standard, for 00-Gauge and 0-Gauge, so that in planning it will be known how much distance is required for the respective units. The advent and deserved popularity of the Two-Rail System, as well as certain long-standing considerations in operating, make some types of points less desirable than others. The scissors crossing was always a difficulty in model work, owing originally to the problem of securing good third-rail contact at the diamond. With two-rail this difficulty is considerably decreased when correct insulation is applied. Much the same applies in the case of two-rail to the slip point, whether single or double. These are extremely convenient and useful appliances from the standpoint of space conservation ; but their insulation, while it can be quite satisfactorily negotiated, is not the simple job the amateur would enjoy. In all the layout designs here given, therefore, slip points have, at considerable sacrifice of appearance and space, been dispensed with unless absolutely essential. Much has been said already concerning the desirability of accurate track-laying, and the photograph

of the Harrow Club tracks in three-rail will afford a good illustration of what is meant.

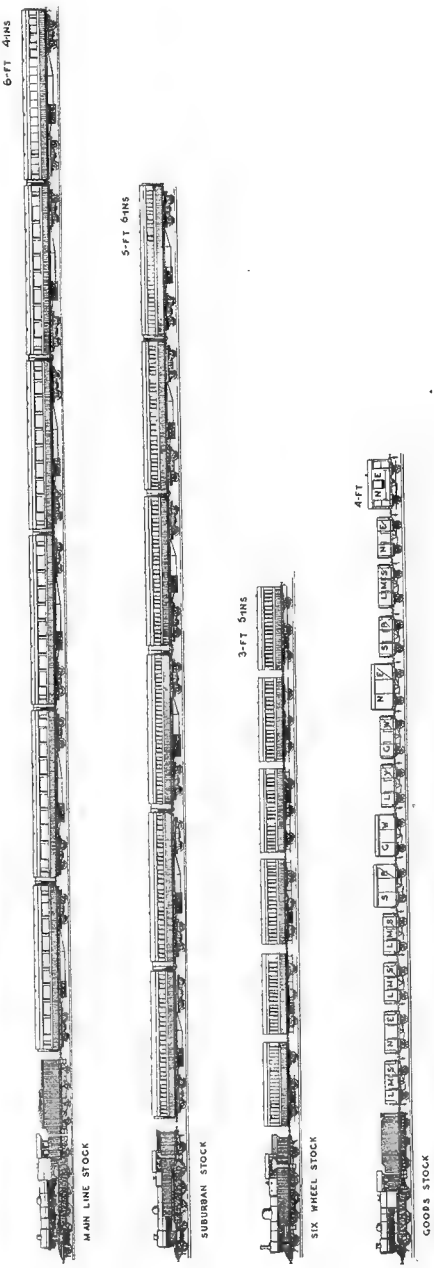
An interesting comment on double junctions is made by Mr. Gilbert Thomas in his recent and most excellent book *Paddington to Seagood*, which is worthy of repetition. In recommending the beginner to use left-hand double turnouts in place of right-hand ones, he says, " With a right-hand double turnout, it is the incoming train which, just after taking facing points on the bend, has to negotiate the ' frog,' against which it tends to knock, whereas in the case of the left-hand turnout, the outgoing train can take the ' frog ' in its stride. The very flat angle of the ' frog ' on a real railway can rarely be possible in model practice, and I recommend the beginner to use left-hand double turnouts for choice." This advice is very sound ; but it may be added that much of the " roughage " at double turnouts can be avoided by employing standard straight diamonds in place of the usual curved diamonds as commercially supplied. By eliminating the curve of the diamond in this manner a vast amount of the strain of the rails against the flanges of wheels is avoided.



SUPERIOR THREE-RAIL TRACKWORK IN 00-GAUGE BY MEMBERS OF THE HARROW CLUB

STANDARD TRAINS AND PLATFORM LENGTHS

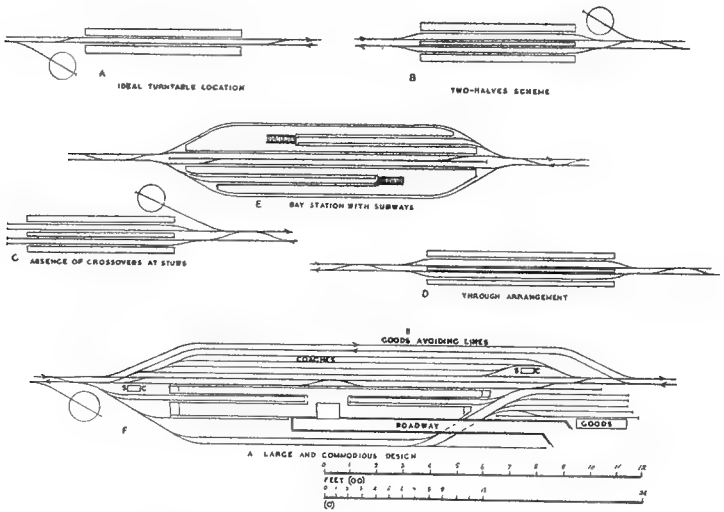
(00 - Gauge)



PROVISION OF FACILITIES

We come now to the interesting and important description of the various facilities required for different types of stations, whether passenger, goods or locomotive depots, and the bearing of this subject upon that of layout planning. It should be pointed out in the first place that the kind of facilities laid down should be proportionate with the amount and type of traffic to be handled at the particular place. We have already discovered that extravagantly large traffic centres are almost always ruled out on the normal form of layout. There may be notable exceptions to this rule, especially as regards goods and engine power ; but normally the facilities will be of medium capacity or small in extent.

Dealing first with passenger traffic, I have given a diagram with a view to illustrating the requirements in platform and station length. In it, the reader will find three six-vehicle passenger trains. There will be few layouts capable of handling regularly trains of greater length than these, unless it be merely for the sake of test loads, for the simple reason that a six-coach train of the first type will require a platform length of fully 6 ft. 6 ins., exclusive of the 18 ins. demanded for a crossover at the platform end. But this train has for its consist six coaches of the main line style, representing in 00-Gauge a length of 10½ ins. each. If the operator is content to run coaches of the suburban length, which works out at about 9 ins., the platform length for such a train and a suburban engine (tank) will be 6 ft. 6 ins. And if six-wheeled coaches are found satisfactory, with a tank locomotive, there is an enormous saving in length, 3 ft. 6 ins. being ample. Here, then, is a matter to be early decided upon : what type of passenger stock is to be the order of the day.



PASSENGER STATION FACILITIES

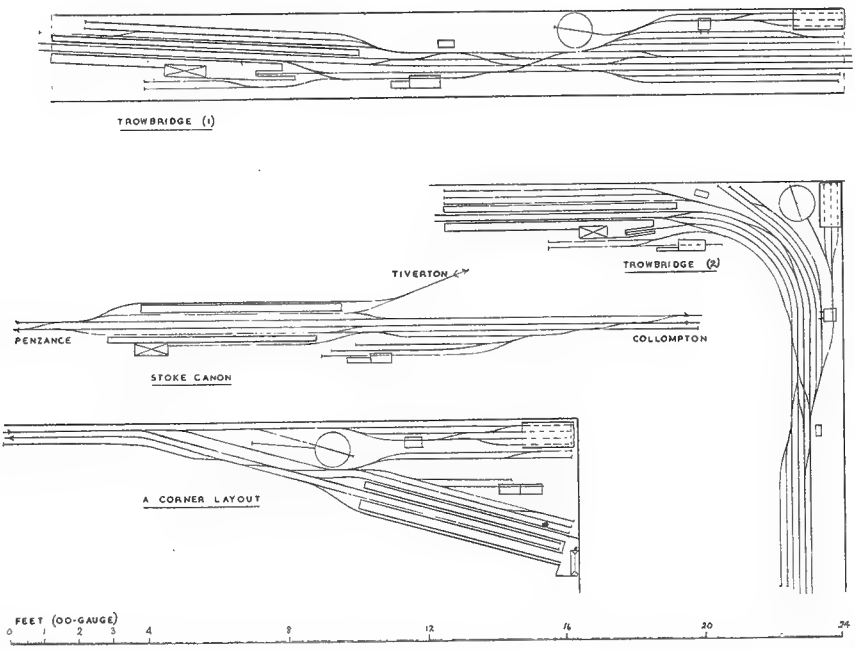
Passing to the next set of drawings, there are given a series of helpful suggestions for station planning generally, both for 00-Gauge and 0-Gauge. An essential matter is the location of turntables at terminal points where passenger traffic is the most important feature. In these cases, the turning mechanism for engines should always be as close to the platform tracks as to require the minimum of engine movements. The

ideal location is indicated in A. Here, arriving engines are on the turntable in two movements, while the turntable track has a trailing relationship to the main line, and should be protected, ideally, by safety points. The arrangements for turning trains of coaches are alike simple and satisfactory. Increased facilities in B are arranged on the " two halves " principle with equally convenient servicing, and in C we have the custom, common in miniature layouts, of eliminating the arrival crossovers for engines, and providing for the withdrawal of coaches of arrived trains before their relative engines are released. The two-halves scheme roughly shown at D makes clear the need of double crossovers at each end of the station, as distinct from what is required at a terminus.

In E, we have a plan for a bay-station, providing not only through platforms, but also terminal platforms for either direction, while at the centre of the layout there is a third track by means of which excellent provision is made for the handling of main line coaches without blocking the main lines themselves. A considerable reduction of the total length of the station is secured by the use of a passenger subway in place of the usual footbridge. The advantage of such subways is that they may be sunk at almost any convenient place.

The design in F represents a really ambitious scheme for all services, and has for its original the somewhat interesting and unusual facilities at Cambridge. Here the services are combined through and terminal. It will be found that there is only one single-sided through platform for both up and down trains, but its capacity allows for very long combinations, and the through tracks have double crossovers at the centre. At this actual location, the trains usually cross over and arrive at the far end of the through platform. There is splendid coach accommodation at this station, and there is also the added attraction of a double goods avoiding line, as well as the necessary freight facilities for stopping-trains.

In the next series of plans I have continued to adhere to the reduction of actual railway layouts to miniature scale form—one of the most fascinating methods of station design. Three of the schemes outlined are taken from existing stations on the Great Western Railway. The plan at A is a more or less accurate replica of Trowbridge, and may commend itself to those engineers who are not trammelled by space restrictions. The traffic arrangements are exactly like those of the original and embody several characteristic features. The station comes at the end of plain double main line track and at the beginning of a four-track section. Slip points alone have been eliminated, excepting in one instance, which might be also dispensed with if desired. There are coach storage tracks for the separate up- and down-



PASSENGER STATIONS WITH ADDITIONAL FACILITIES

lines, and the goods reception road lies in the immediate rear of the goods shed. Eastbound goods trains pass through the station to the far slow road, and then back into the goods track over the through crossovers. Westbound freight trains also enter the main station and back into the goods reception track, and in this manner a number of facing points are eliminated from the main line. The locomotive yard is well equipped with all requirements, including correct storage and operating sidings for coal trains supplying the stage. The layout would occupy the entire length of a good-sized room, but is excellent and commendable for a miniature system.

In B, the same layout, with negligible alterations, has been adapted to a corner, and could therefore be arranged in a smaller room. The main difference in this layout is that the engine terminal has been turned around to occupy the corner itself. This is really an advantage " in miniature," since it dispenses with yet another facing point, though on a slow line.

The scheme of C represents a more modest design of station, which is also a junction, the prototype of which is Stoke Canon. The main line here is double track, widened at the platforms by additional slow tracks for the up and down directions, so that fast trains may pass through with a

minimum of traffic interruption. The branch (actually to Tiverton) is single track, using the up platform as an island. The goods yard is extremely similar to that at Trowbridge, though westbound trains have direct entry. Eastbound trains pass through the station and reverse to the yard by way of the crossovers.

This method of adapting actual prototypes to the exigencies of model station design, while it is by no means the only permissible method, has great attractions, and provides an excellent safeguard to the novice against incorrect planning. It also lends itself to the employment of considerable art and ingenuity.

For those who prefer to work entirely by disciplined imagination, the remaining plan follows this order, being freelance, and has the outstanding quality of occupying a corner. Every facility is amply included, even to adequate cartway access to the goods department. There are no coach storage roads in the layout, but there is a satisfactory coach headshunt, which might be extended, or duplicated, to provide as many such tracks as required. A similar shunting spur is provided in the goods yard, with access at both ends for locomotives. The locomotive shed will accommodate four or five engines, and the coaling stage has correct siding approach.

In the layout of passenger stations there are certain other important matters to observe, such as the provision of facilities for handling milk, horses and pedigree cattle, as well as road vehicles transported by rail. The need of these arrangements at the various stations will vary greatly; depots in agricultural districts and at market towns will require their suitable equipment and sidings, the latter being usually of the bay type with provision for end- as well as side-unloading and loading. Milk is usually handled in small stations at the arrival platform used for passenger trains.

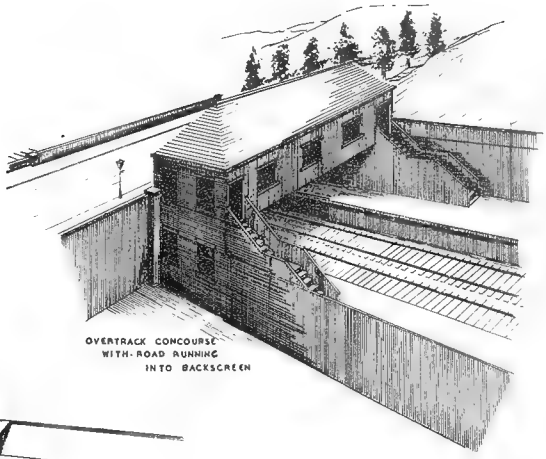
One of the most important and difficult features of planning for a restricted site, such as an ordinary indoor space allows, is that of providing for the street access to station concourses. It will often be found that after a quite heavy track problem at some station has been very nicely negotiated there is simply no place for the road entrance to the depot. Here are some of the alternatives for overcoming this trouble :—

A right-angle overtrack concourse with road into backscreen.

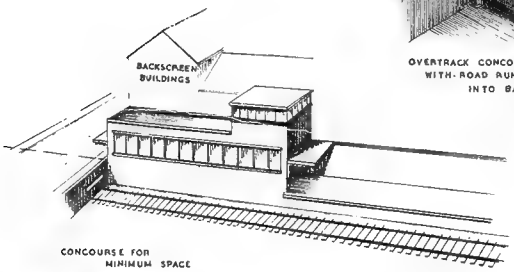
A concourse entirely covering the inner end of platform, and flush with backscreen; footbridge connection for other platforms.

A series of platforms with nothing but subway connections, concourse being invisible or forming part of backscreen view.

A low-level concourse with facing only, allegedly built below the platforms.

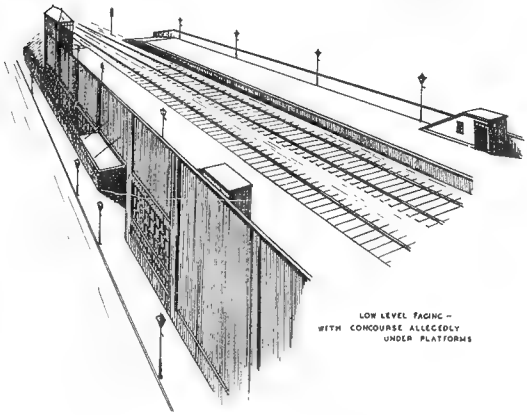


OVERTRACK CONCOURSE WITH ROAD RUNNING INTO BACKSCREEN



BACKSCREEN BUILDINGS

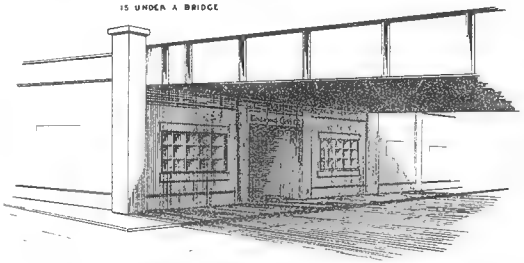
CONCOURSE FOR MINIMUM SPACE



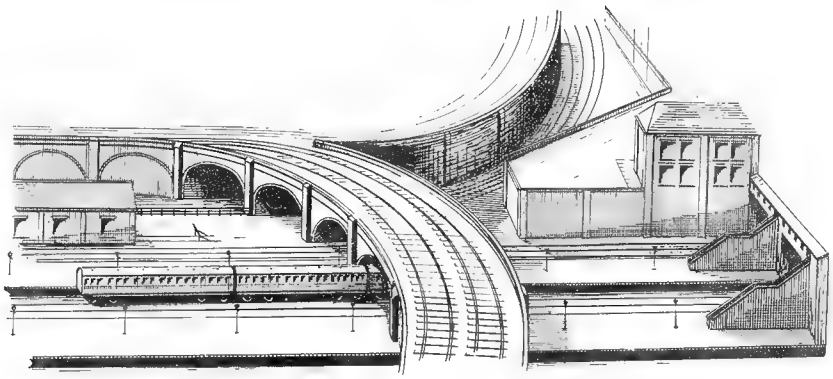
LOW LEVEL FACING – WITH CONCOURSE ALLEGEDLY UNDER PLATFORMS

HIGHWAY APPROACHES

AN EXCELLENT PLACE TO PUT THE CONCOURSE IS UNDER A BRIDGE



There are actually a large number of ways of meeting the situation when it is borne in mind that the approach may be either ground level, high level or low level. If there is a bridge adjoining the station, an excellent place to put the concourse is under the bridge, especially if it can be electrically lighted to show it up. All these expedients, of course, refer to tight places ; but if care is taken it is not always hard to leave plenty of space for a perfectly normal entry.

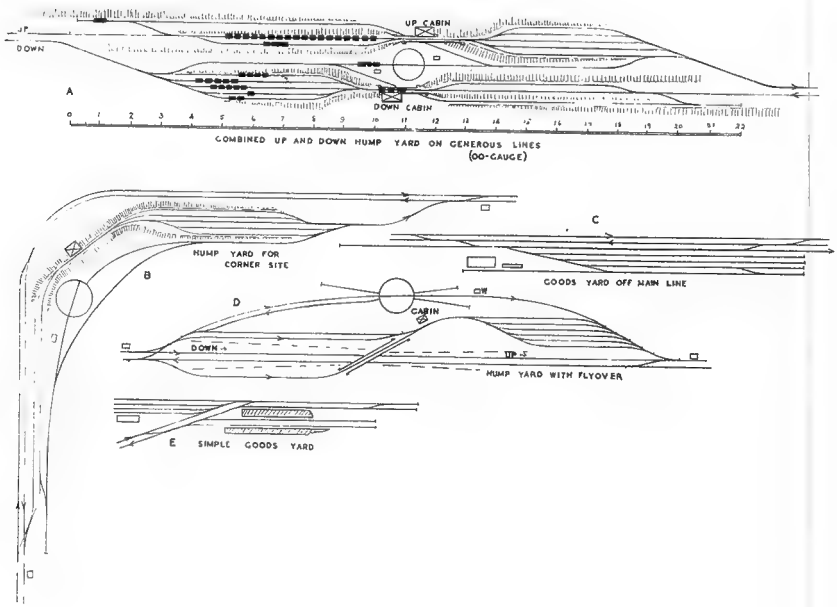


THE POSSIBILITIES OF PLACING THE CONCOURSE END OF A STATION IN A CORNER

An illustration in the form of a sketch is given to show the possibility of placing a concourse in an awkward corner where the platforms terminate at a blank wall. A building with a high-level roadway behind it, placed flush with a background scene, is provided with a covered corridor having stairways down to the platforms. This drawing actually depicts one of the stations in the layout plan given in the first handbook of this series (*Before You Begin*), and at later stages we will include other sketches of features of this same railway.

So much, then, for passenger facilities, details of which must be kept constantly in mind by layout designers.

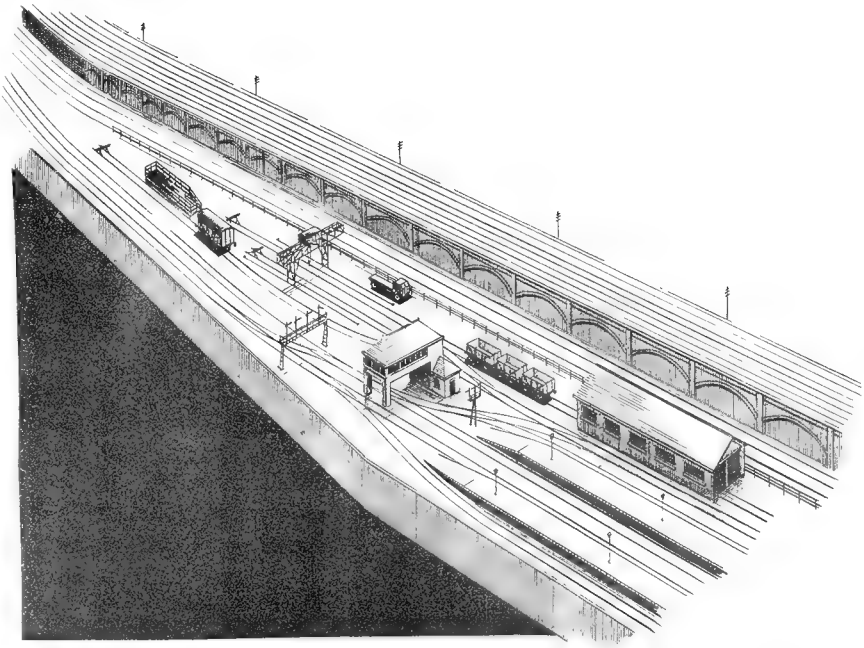
Goods yards are divisible into three groups—level yards, gravitation yards and hump yards. For model work we may perhaps eliminate the second group, for gravitation yards—in which the wagons are shunted by the provision of a down grade requiring no track-rise—are closely related for our purpose to hump yards, which include the added feature of a rise as well as a fall in the tracks.



GOODS FACILITIES

In the drawings of goods yard facilities, the simplest form of country yard is shown at E. The two shaded blocks are the ends of passenger platforms, alongside of the further of which the goods reception and run-around are situated. Country goods facilities are often very modest in their proportions, though it is good practice always to provide for independent shunting, and to install a reception track with getaway for the road engine. The scheme of C is still simple, though more extensive, the arrangement being laid down alongside an open main line. Note the two main line crossovers to permit ingress and exit to " up " trains. Observe also the provision for engine run-around near the goods shed track, as well as the extension spurs to the reception run-around. The one with the arrow is a locomotive spur, the opposite one being the track for shunting.

A sketch also shows the grouping and arrangement of the equipment about a goods yard of normal type, the yard itself being quite small. Necessary features here included are the cattle pen, goods shed, sidings, and a gantry crane with cartway. Passing main line tracks are fenced off to the rear. Other common requirements are coal offices, yard crane and possibly an oil storage tank, each having its own siding accommodation.



THE GROUPING AND ARRANGEMENT OF THE EQUIPMENT ABOUT A GOODS YARD

The goods yard plans already given in connection with passenger stations will be found worthy of study, and there is a very good plan included in the layout for a complete terminus in connection with locomotive depots, a feature of this plan being the additional spur for loaded wagons bound for the locomotive coaling stage.

Returning, then, to the diagrams for goods facilities, let us pass on to study the possibilities of the hump yard, which is a feature rarely modelled owing to its somewhat heavy demand on space, but which is very well worth including on any layout where possible. Nothing in the way of track arrangement in miniature could be quite so fascinating to operate or to build, and the carrying out of the exact procedure of an actual yard is readily compassed. In the diagram of the combined up and down hump yard on generous lines, I have designed a scheme exactly identical with a famous instance, though with a restricted number of roads, and have done so without great concern for the space monopolised, though I have also included later a complete railway layout embracing this precise plan. In the

drawing I have also indicated the position of imaginary trains, so that a perfect idea of the working can be had. Thus, in the "up" yard at the top, a train of 18 wagons has just arrived on the reception track, and its engine is in the act of running around it, being meanwhile "in wait" for the shunting engine in the spur first to hook on to the rear of the train. When this has been done, the main line engine departs over the crossovers, down the grade and under the bridge to the turntable or water tank, when it can either proceed to other assignments from the " down " yard or go to pick up its own train at the opposite base of the classification tracks. The shunting engine in the interval pushes the arrived train, now uncoupled, over the bridge and hump, past the cabin, where the wagons are classified by handling the point controls.

In the " down " yard, this work has just been completed, the last pair of wagons being in the act of rolling off the hump at the uncoupling ramp, the remainder being already sorted. The main line engine of this train is already at the water tank, almost ready to pick up its load. It will be noted that there is an entrance at each end of the yard for the respective " up " and " down " traffic, and that the locomotive tracks in both yards are connected over the turntable. An effort has also been made to indicate the shape of the gradients. The turntable is installed merely for the purpose of turning " up " locomotives taking " down " assignments, and *vice versa.*

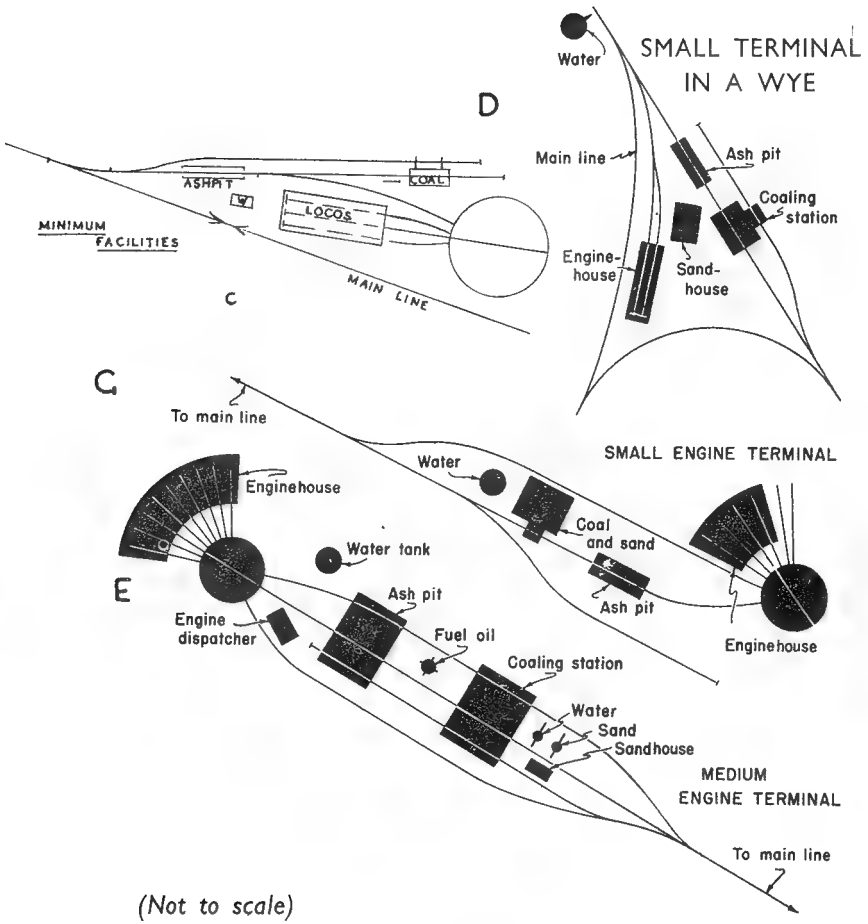
In B, we have a layout for a single yard only, this time located on a corner. At such a site the demand on space will not be prohibitive, while for the single yard the facilities are just the same as for the double one. The interesting idea of D is that of the flyover to the hump, with slightly varied locomotive track arrangements. An " up " train enters the yard in the normal manner from the west. It proceeds into the reception track with the arrow, its road engine getting off by the run-around on to the ingoing track to the turntable. A shunting engine, waiting in the outgoing track from the turntable, gets behind the train and does the hump service, the road engine passing over the turntable to the east end, to pick up its train when sorted. Down trains arrive at the yard by reversing and backing in. After that, the manoeuvres are the same. It will be noted that the main lines are depressed under the bridge and, of course, the tracks to the bridge are graded in the opposite manner, this double grading providing for the requisite difference in levels within a quite short space.

In forming a baseboard for a hump yard, it is a good scheme to arrange for that portion under the hump—if possible—to have a variable

A LAYOUT FOR A COMPLETE TERMINUS WITH ALL FACILITIES

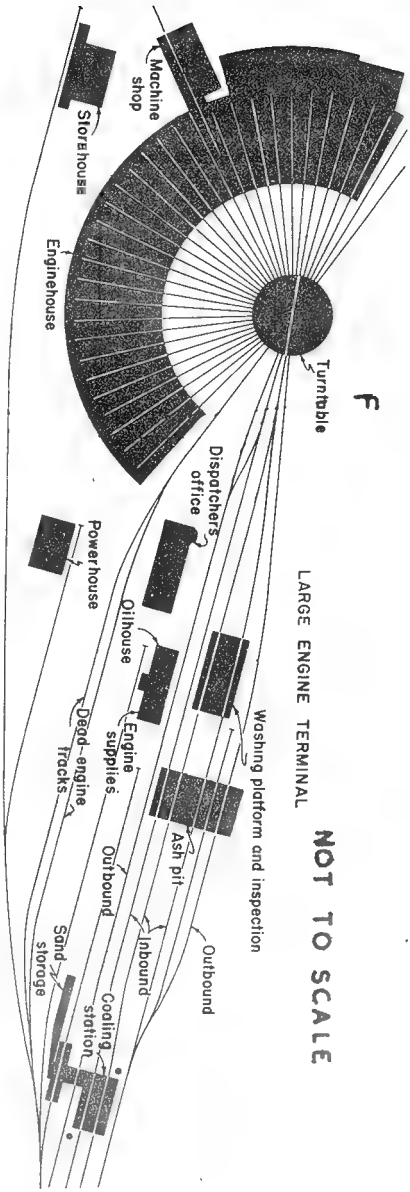
SMALL LOCOMOTIVE DEPOT WITH WYE **B**
(Not to scale)

TERMINUS AND LOCOMOTIVE DEPOT. *Further Locomotive Depots are shewn on the next pages.*



gradient. The way to do this is to leave an adjusting gap under the topmost part of the baseboard, upon which, with the aid of long screws, the board can be pressed down or released at will, and the slope altered accordingly. Take care not to place the screws so that they will come under the actual tracks. This expedient will provide for the adjustment of the slope to suit whatever type of undercarriage is used for the stock; and it may be mentioned that where hump yards are in use on a model layout, all the stock should have the same type of running gear. No satisfactory working substitute for the wheel retarder has yet been designed for the lighter gauges.

Locomotive facilities are of the greatest possible interest, and should be installed with such exactitude as will enable engines to pass through the necessary track movements for servicing as required by the working timetables of the system. It is almost universal practice to put engines through this servicing on their arrival in from duties, so that they are ready at any moment for assignment after the engine crews and shedmen have done their work. Thus, an engine, on arriving after its day's run, has its fire raked out, its coal bunkers filled, its water tanks replenished, its sandboxes refilled before it goes off duty. The various items of equipment for the carrying out of these movements are required at every depot of any considerable size. There will thus be ashpits, coal stage, water tank and standpipes, sand supply, turntable and inspection pits demanded. In the diagrams of locomotive yard layouts, it will be found that A gives a very fully detailed scheme for a depot which will, according to the requirements of a miniature system, be quite extensive. Here we have housing for half-a-dozen large express engines, with all the facilities already outlined. The yard entrance is excellently placed, and the track so arranged that engines can get straight to the turntable, for mid-duty turning, or may enter over the ashpits, past the coaling stage and through the the shed. There is a servicing track on which coal wagons supply fuel to



F

LARGE ENGINE TERMINAL

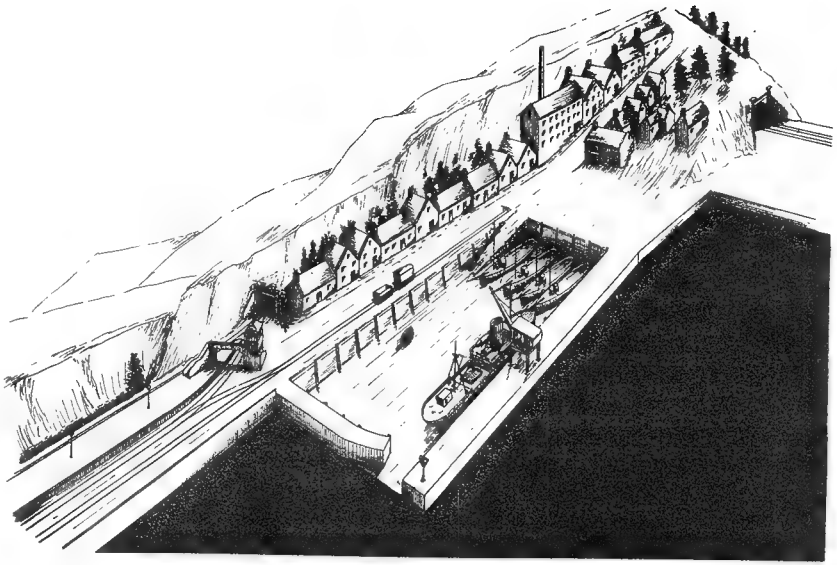
NOT TO SCALE

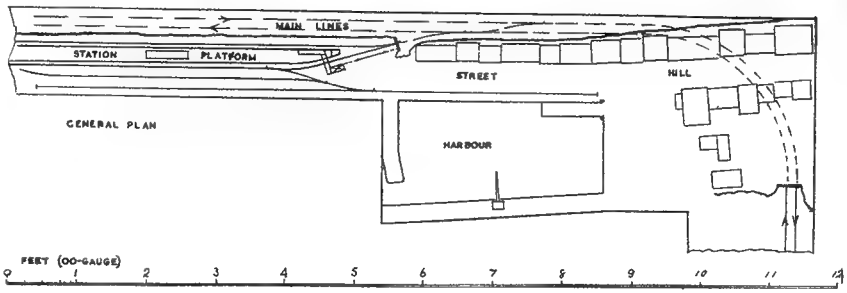
the stage, and all the outgoing tacks are served by the latter, if this is needed. An interesting scheme for a very small depot is given at B, where the yard is located in the bosom of a wye, over which engines can be reversed in lieu of a turntable. The wye takes up very little space, is half-concealed in the tunnel, and does not involve the blocking of the main line, which may be either single or double. The coaling appliance here is of the ancient type having a fairly steep incline up which the wagons are pushed. Coaling is carried out on a separate track. In C, we have the bare minimum of facilities for a country depot. The coaling plant here would be of the light capacity, small, but modern kind. It should be noted that where there are ashpits, there should be wagon access to these.

The American type of depot varies considerably from the British, and I have included three designs of plans from the *Model Railroader* which, though not to the same scale, will illustrate the requirements. D is a small country depot in a wye ; E is a medium capacity yard, while F is a large type of terminal with accommodation for over 30 engines. G is a small yard with turntable and roundhouse. The roundhouse makes a truly fascinating model, though not easy to construct with unskilled hands. Roundhouses are by no means unknown in Britain, many of the older yards being thus equipped. It is therefore quite sound practice to instal a correctly designed instance on a British model.

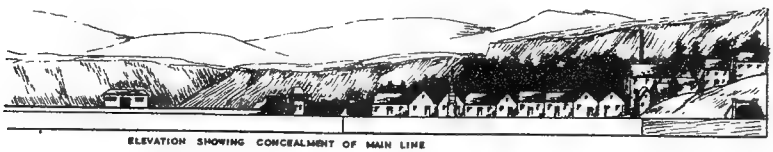
The discussion of the work of constructing the various appliances for a locomotive yard belongs to another branch of our subject ; but enough has been written, perhaps, to provide for all the needs and for the full guidance of the layout designer.

There are necessary observations to be made, too, in relation to the planning of docking facilities and the various track approaches to industrial sites. A dock location of some kind on a layout of any considerable size is a feature of great interest, from both the operational and scenic standpoints. The dock may take the orthodox form, representing a single shipping basin adjoining an imaginary port, or it may be more modest in its pretensions, and take the form of a canal or riverside quay, or—what is even rarer in the model realm—one of those small fishing villages with attractive rows of cottages abutting the lower edge of a cliff, the shipping facilities providing merely for small motor-craft and an occasional miniature tramp steamer. I have chosen a design of one of these village frontages, the sketch of which will furnish an idea of its scenic possibilities. It will be seen that the main line of the railway passes behind and underneath the cliffs, and has a branch leading out into the village station, where the siding accommodation merely allows for the dropping and taking up of a couple or so of wagons. At the right-hand corner, the village road takes a gradient,



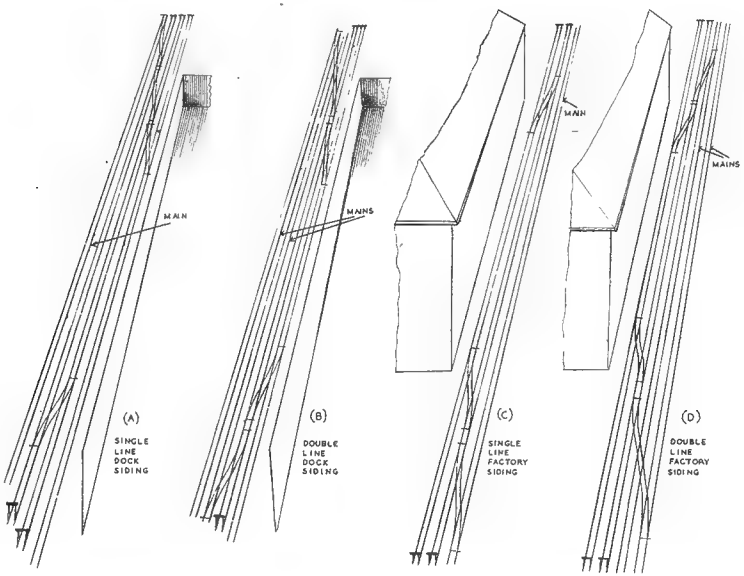


FISHING HARBOUR LAYOUT



ELEVATION SHOWING CONCEALMENT OF MAIN LINE

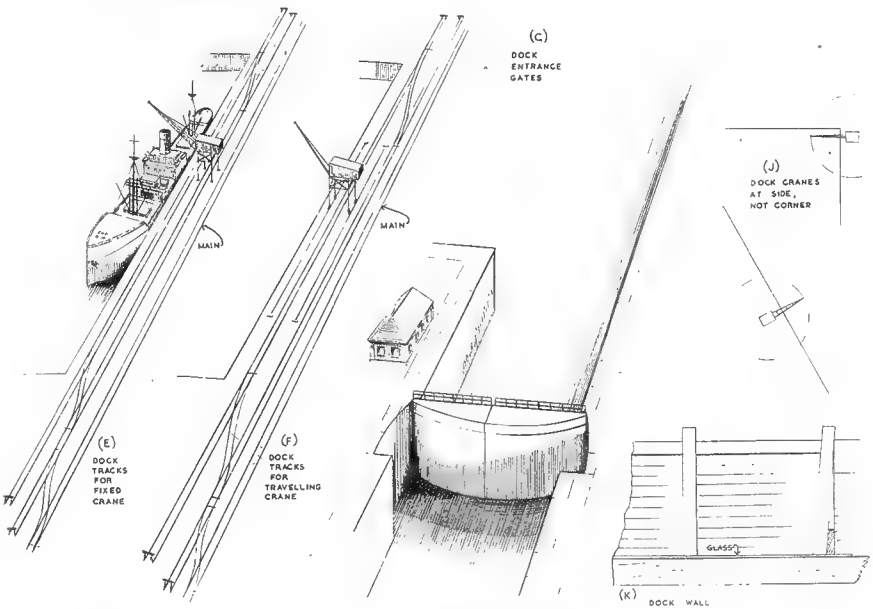
which serves to permit the double tracks to pass underneath. A diagrammatic plan is also given to provide the necessary layout planning guidance. In this scheme, an otherwise problematic corner of the layout has been effectively utilized, and the station, though small, is of standard length, and allows for the operation of freight traffic just as literally as a larger depot would have done. From this centre, fish trains of small capacity may be regularly run, and an oil depot may be installed for the supply of crude oil to fishing craft.



INDUSTRIAL SIDINGS

In arranging dock tracks, as well as those for industrial purposes, there are important factors to attend to. A diagram gives numerous hints as to the nature of these. Thus, in A, we have the correct arrangement of approach tracks for a single line railway, and at B the arrangement for a double line. There must be the usual reception siding with locomotive run-around road, and an extension for the purpose of shunting, if necessary. C and D provide for the same features at a factory site. It is bad practice to run out a simple lead as a siding for a factory, though this is very often done. By this procedure, no method is provided for the movement of wagons without completely fouling the mains; and very often, in fact, it would be impossible to extricate the engine of the arrived train when the wagons had been deposited.

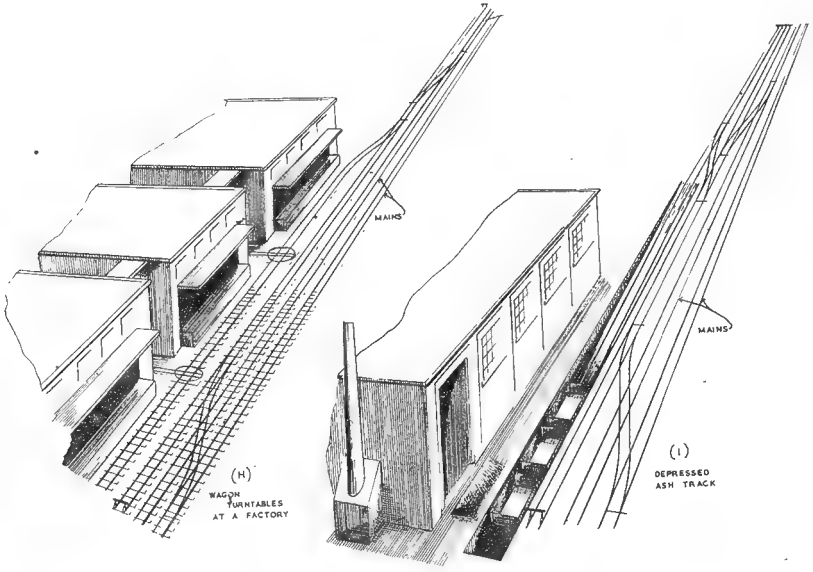
Cranes should be so located as to serve the *holds* of the vessels by the quays, and the capacity and size of the crane depends wholly on the nature of the dock. For a small depot like that of the sketch herewith, the cranage would necessarily be of the cruder or more primitive type, and one crane would probably require to serve all purposes. For a large dock, the cranage would be a different and a much more ambitious affair ; a pair of track jib-cranes might require to be provided, and these could take a very modern design. It should also be mentioned that a dock does not need immediately to adjoin a passenger or freight station ; it may be an integral feature, removed from any other sort of railhead. Canal docks are very attractive for the modeller, in that they are most picturesque and take up the minimum of space.



The formation of the " water " surface of a dock basin is another subject attached to our survey. The best material, I have always found, is plain sheet glass, laid on an underfacing of red-brown paint. A good effect is secured by laying the glass while the paint is wet, so that it adheres in patches to the glass and gives a somewhat realistic appearance. Plain glass is best because dock surfaces are seldom rippled, and the smooth surface allows for a correct amount of reflection. The basin should be sunk into the baseboard to a distance of about 2 ins. for 00-Gauge, and the sides should be covered with either a heavily timbered or an " old stone "

wall. Provision may also require to be made for water-gates at the dock entrance, these features being planned as dummies, but being very attractive when finished. These various features are provided for in one of the diagrams (G).

Tracks at factories themselves can follow numerous arrangements, and here an opportunity is provided for the installation of wagon turntables. Several schemes are given in diagrams.



Let us, then, briefly recapitulate the various facilities we have discussed as they affect the designer of layouts ; and let it be noted that each operating centre has its specific requirements, according to its size and capacity.

Passenger Stations : Coach sidings ; coach cleaning track ; adequate platform length ; shunting without fouling mains ; footbridge connection between all platforms ; all platforms ramped at open ends ; safety-points at sidings off main line ; signal cabin at each entry and exit to main line ; correct street approach to concourse ; no track gradients.

Goods Stations : Separate goods train reception track, with run-around alongside ; shed track independent of marshalling and storage tracks ; turntable as near main line as possible ; cartways between tracks as

necessary ; adequate shunting spur issuing from reception track ; crossover to or from up- or down-main ; goods shed or warehouse ; coal offices ; oil depot ; cattle pen ; suitable cranage.

Locomotive Depots : Provision of facilities for servicing of ingoing engines ; coal stage ; water tank and standpipes ; inspection pits ; ashpits ; furnace for fire kindling ; locomotive shed ; turntable or wye ; direct access to turntable, if possible, without blocking shed tracks or passing through shed ; coal appliances as far from passenger platforms as may be ; storage for sand and oil.

Docks : Suitable reception tracks and shunting roads ; cranage ; capacity of basin equal to size of craft to be served ; lock gates ; offices ; correct depth of waterline ; dockside tracks permitting free movement of engines.

Factories : Correct arrival and departure tracks in relation to main line ; adequate shunting facilities.

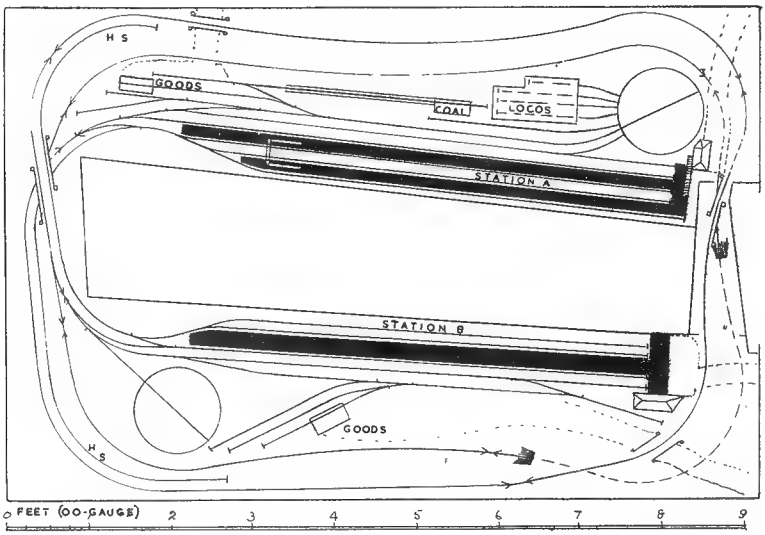
SUGGESTED LAYOUT DESIGNS

At an earlier stage we touched briefly upon the various probable sites for layouts and described their likely location. Returning to the point where we than left off, let us consider their various possible sizes, thus :—

Bedroom averaging 16 ft. by 11 ft., with
Dressing-room adjoining averaging 9 ft. by 6 ft.
Living-room averaging 20 ft. by 15 ft.
Box-room about 10 ft. by 8 ft.
Stable loft or attic up to, say, 30 ft. by 18 ft.
Small bedrooms joined by landing each about 15 ft. by 12 ft.
Garage averaging 15 ft. by 9 ft.

As admitted, these dimensions will vary, but the prevailing average will serve as an adequate guide. We may, therefore, now proceed to the discussion and description of some actual schemes.

Our first is the simplest and smallest—a plan for point-to-point running, having provision also for a continuous run, the main lines being single track. It is arranged to suit a room like an odd store-space or small garage, and it has two excellent merits—a well-conceived main line and two lengthy stations. The doorway is considered to be in the centre of

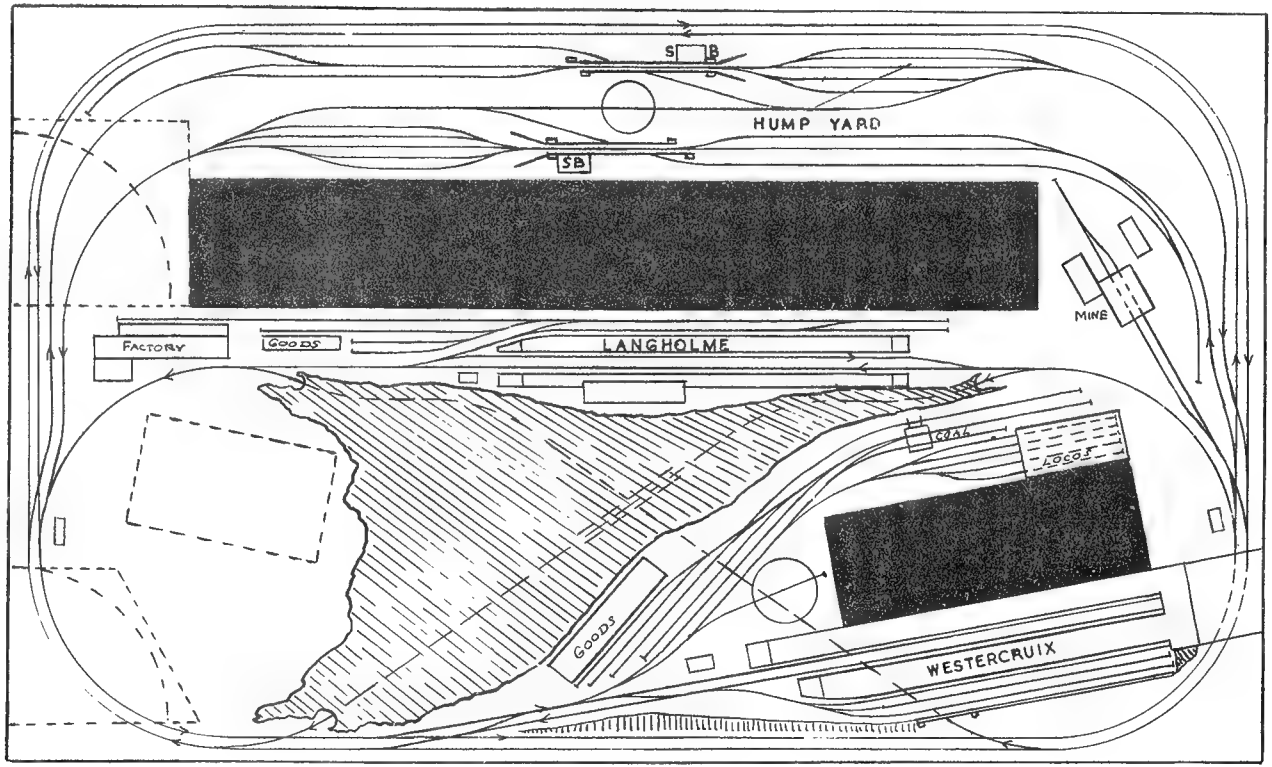


SMALL POINT-TO-POINT LAYOUT

(With Continuous Run)

one end, and at this place there is a short lifting section of baseboard to allow entrance. Most of the scenic arrangements and embellishments are left to the ingenuity of the builder; but provision has been made for road access to all stations and goods yards. At the north station there is provision for the servicing and storing of locomotives, with an old-style incline-type coaling stage. Coaches at both stations are handled over headshunt tracks and may be manipulated and arranged at will. Goods facilities are modest in both instances, but sufficient for the size and claims of the layout. The concourse to the north station is at the high level, and is provided with stairways down to the tracks. The southern station is itself built at the high level. This is a layout which will probably appeal to many, if only on account of its modesty and its demonstrable claim to have made the utmost of a small area.

When discussing hump yards, a promise was made to include a scheme which should embody a good example. Our second plan makes this provision. Its location would require to be a vacant bedroom or living-room 20 ft. by 12 ft. The hump yard occupies the whole of the northern wall, with approaches and exits encroaching upon the sides also;



LARGE GARAGE LAYOUT

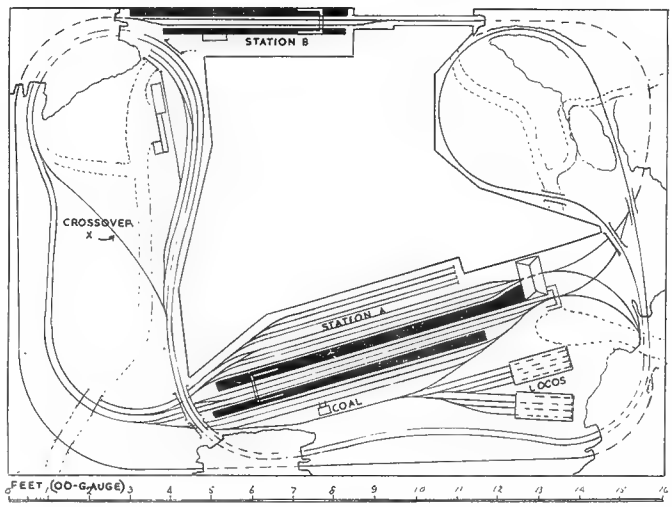
(With double hump yard)

00 CAUGE

20-FT BY 12-FT

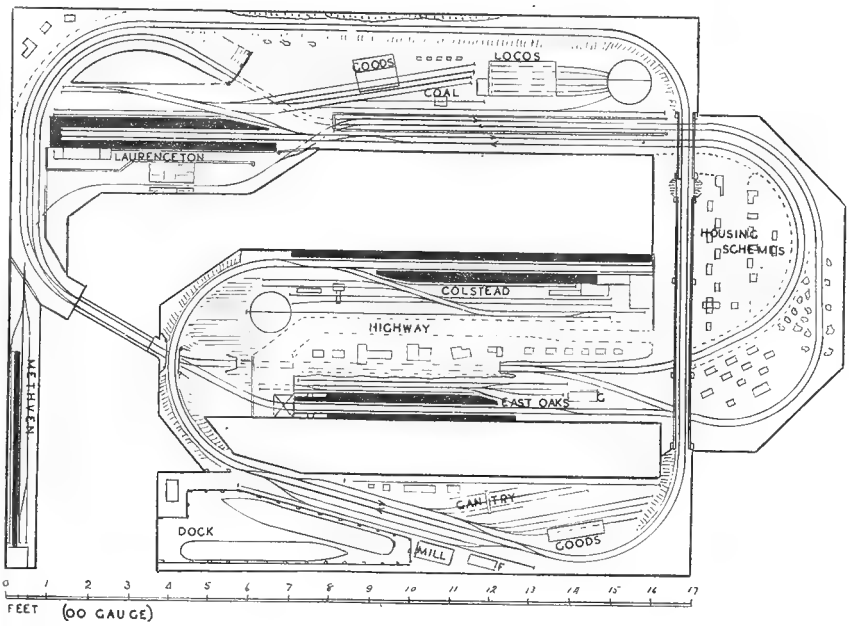
0 1 2 3 4 5 10 15 20

but all the remaining space is given over to a normal layout which in itself provides quite workable attractions. Two locations have been indicated as possible doorways, and the dotted rectangle on the west side represents a movable section to allow access for track cleaning. The main line, which extends the full round of the room, should be so graded as to provide a rising entrance to the hump yard reception roads, which are themselves on the high level. The hump sorting tracks run down, of course, to the low level, and at this grade leave the yard. It would be possible, therefore, to divide the rise and fall between the incoming and outgoing tracks, thus halving the length required, and halving the height demanded on the outside main lines. The southern layout is quite good. Starting from Westercruix, we take a complete circuit of the room, down to the south-east corner, where the tunnel under the station is taken. Running under the mountain, we take the south-west loop, continuing right past Westercruix station and reaching Langholme, a large way-station, from the east, after again passing under the mountain. Continuing, we again take a complete circuit around the layout, again passing under Westercruix, and thereafter making our arrival at that station. The run is extremely lengthy, and may be increased by taking further laps of the main. There are several industrial sites, and at Westercruix there is a very large freight depot, with full locomotive facilities adjoining.



LAYOUT WITH LARGE THROUGH STATION

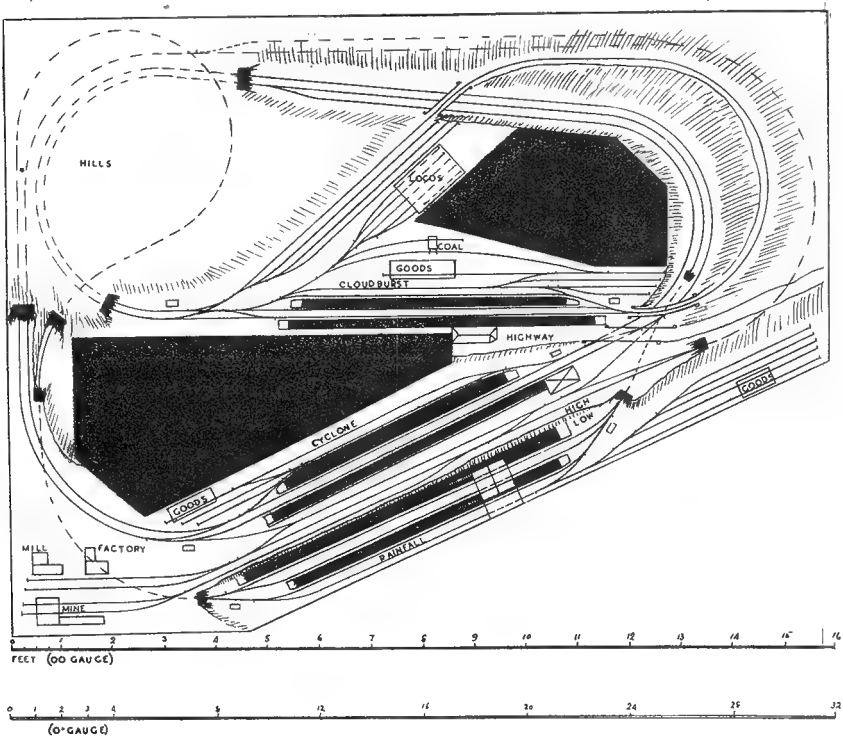
There are no termini in the next layout, the idea being to provide for a spare bedroom, 16 ft. by 11 ft., a system having one large "through" station, with a small passenger halt for added interest. From the western side of station A double tracks take the open country on an attractive continuous route until crossover X is chosen, this serving to reverse the direction of the trains and eventually bringing them back the same way as they left station A. The way-station is on the single road which leaves station A on the east side, and the roads are so arranged for main line work that practically no locomotive turning is required. The engine depot is at station A, where there is also very lavish coach accommodation and an extensive goods yard. There is a factory, with correct siding approaches on the west side.



PRESENT FORM OF THE WEST MIDLAND LINES

Readers may be interested to have a plan of the West Midland System, in its present form, though, sad to say, at the time of this writing there are heavy permanent way replacements afoot and the system is temporarily out of service. Everything is, however, in place except the track, most of the stations having been re-designed. The plan will indicate that a very full system can be installed in an ordinary large living-room.

Since the tracks were taken up, all the gradients have been eased, additional operating spaces provided and a large mantelpiece removed. A nasty double-track loop on the north-west has been eliminated, and a single road has been taken out as a branch to Methven, over an old-style American trestle bridge. The docks have also been enlarged.

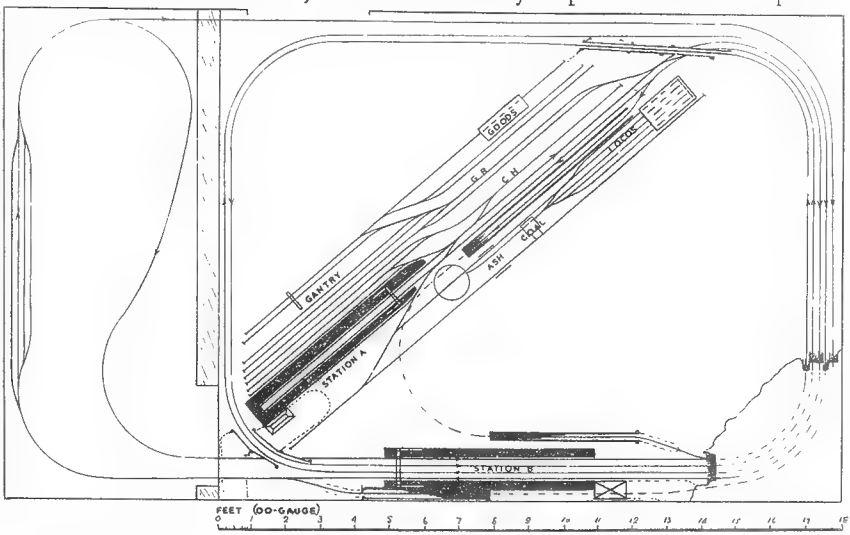


LAYOUT FOR RECEPTION ROOM

(With interesting main lines)

The hand of Linn Westcott is very obviously to be traced in our next design, which has extremely interesting main lines, and is suitable for a spare bedroom or reception-room 16 ft. by 12 ft. The three stations, which I have named Cloudburst, Rainfall and Cyclone respectively, have been re-designed to suit British practice. Two-rail workers should fight shy of the double-slip to the west of Cloudburst, substituting crossovers further along the mains. Note that the stations are all three at different levels, the main lines being extensive enough to permit the necessary gradients under quite lenient conditions. There are actually no terminus

stations in the scheme, and no turntables, though at Cloudburst, which takes the form of a through station with reversing loop, engines can be easily reversed if desired. It is here that the locomotive depot is conveniently located. There are also commodious coach tracks. I ought also, for the sake of a rigid consistency, to indicate that there are no facilities for handling coaches off the main lines ; but these can easily be provided where required.



LAYOUT WITH REVERSE AND CONTINUOUS RUNS

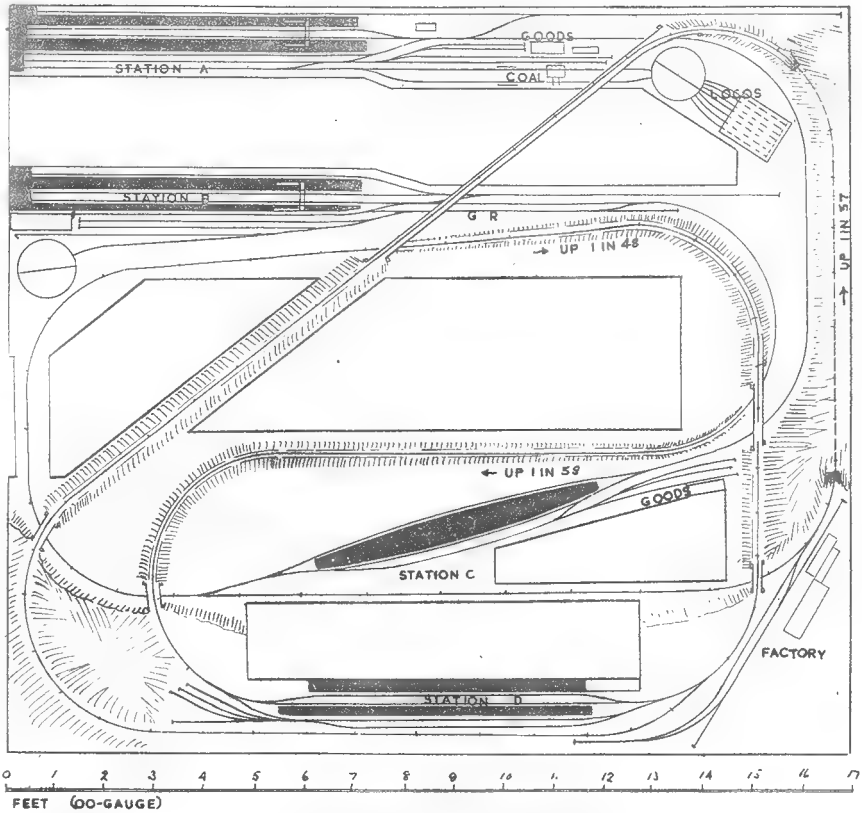
(Inside express lines at way-station)

I would like now to return to our previous elementary descriptions of main line schemes, with special reference to the last of these that was given—the four-track layout with reverse loops and with inside express tracks at the way-station. In the next plan I have given a design for a completed layout on these precise and fascinating arrangements, the continuous links being an added embellishment. The site would be a vacant bedroom with adjoining dressing-room, the former 18 ft. by 14 ft., the latter 14 ft. by 6 ft.; but it should be noted that a smaller site would take the same scheme suitably reduced in size, though the main station should be kept as lengthy as might be. I consider this layout to be excellent for its lack of extravagance and for its workability and interest. Tracing the route from station A, the reader will find that there is an endless possibility of main line running, and that every time a track is traversed it is taken in the proper direction, without passing any established feature twice *en route*. The route leads out first to station B, which is passed on

the express line. After a circuit of the layout, the train arrives at the down platform of station B for a call. Proceeding, it then enters the side room and either takes the loop or halts at the waiting sidings for a more important or earlier timed train to pass it. Continuing, we may take the repeating link on the extreme north. This avoids station B by way of the burrowing junction, and this full-length loop may be traversed as often as desired. Next, the reverse-loop, which runs down the inside of the smaller room, is followed. The train arrives at station B for a halt on its return journey. It then proceeds over the flyover on the north side as an express through station B in the return direction, and takes the burrowing junction near the entrance to station A. This being a continuous link, the run may be repeated as often as wished over the full layout circuit until station A is eventually reached. The latter terminus is extremely commodious and is provided with every requirement. Industrial tracks may be placed at many points of the system should they be favoured, and the scenic details can be provided to the taste of the builder, provided that proper highway access to the stations is included.

While we are still within recollection of our earlier section on main line schemes, I have included another layout on page 61 opposite embodying the extended continuous line which we previously dwelt upon. If the reader will refer to this earlier diagram, he will observe that it has two dotted link-lines providing continuity of run. Literally, these two tracks are simply an amplification of a plain crossover from one main section of the tracks to another. The dotted amplification shows how this link may be indefinitely extended. In our next layout, then, we have extended it, and for convenience, the extended link has been shown with hatching in the plan. The site might be a reception-room 17 ft. by 15 ft. Leaving station A, we quickly arrive at the island station C, which is off the continuous road, and is therefore only passed once on the journey. Next, the lengthy repeating link is entered, taking what is virtually a double lap of the site before it terminates. Then comes the junction to station D, with the short run to station B, the other terminus. I have indicated the three gradients of the system, all of which are within the lenient limits, though one of them will be steep enough to provide interest. Locomotives are housed at station A, and both termini have turntables. There is a large factory site in the south-east corner and numerous interesting bridge locations.

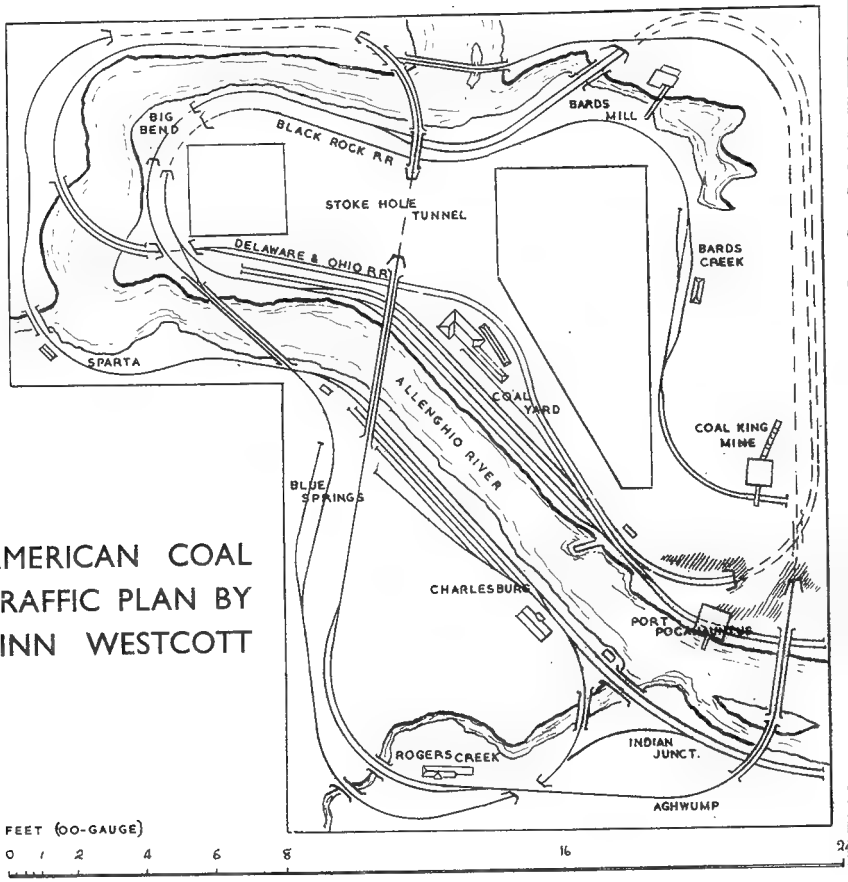
For a layout scheme providing exclusively for coal traffic, I cannot do better than include a plan on page 62 by Linn Westcott on purely American bases, which will provide interest to British modellers of American layouts. I will allow my good friend to describe it in his own words.



LAYOUT WITH EXTENDED CONTINUOUS LINE

" Such a layout is single-minded, but in its very single-mindedness is an opportunity for realistic design and for a railroad different from the usual. Picture dozens of hoppers and gondolas, heavy motive power, long trains, a busy yard with dozens and dozens of the same black, dirty cars. Picture a river down the middle of the layout with coal barges, docks, and car unloading facilities. Picture in the background a typical coal mine branch, single track of course, winding up a grade to a mine on the side of a hill. You can have it all in the space shown, or you can take the same basic plan and change the main line loopings, perhaps eliminate some trackage, and tailor to fit your particular space.

" Even the single-track branch that climbs to Coal King Mine in the hills must be of heavy construction. On the main line the steel



AMERICAN COAL TRAFFIC PLAN BY LINN WESTCOTT

bridges over the Allenghio River afford opportunity for the heaviest type of structure you might wish. The curves can be fairly sharp and yet in accord with prototype lines in the mountains and practical for model operation with freight cars. Articulated locomotives, the almost standard motive power for this type of traffic, also take short curves gracefully, although on double track be sure to figure on the frontal overhang of the boiler.

" Coalyard is the interchange point between the mine branch and the main line. A dummy main line leads ostensibly to the west, and actual main lines lead both to the east across the river and into a tunnel under the same big hill which supports the mine. Another main line

with division point yard is on the other side of the river, at Charlesburg. This looks like a competitive railroad, but if you'll follow the devious routings it's but another looping of the continuous trackage over which main line coal trains are run. Plenty of switching fun can be had picking up and setting off cars at both Coalyard and Charlesburg and making up the branch line trains between mine and river.

" Port Pocahauntus is loading point for coal barges bound down-river. An actual coal loader can be built at the mine, a car dumper at Port Pocahauntus, and cars loaded at the mine can be hauled down to the river, dumped into a barge with dummy bottom, and the coal conveyed under the layout right back to the loading rig at the mine. Thus, loaded cars go downhill, empty cars uphill, while other loaded cars can be used in continuous operation on the main line.

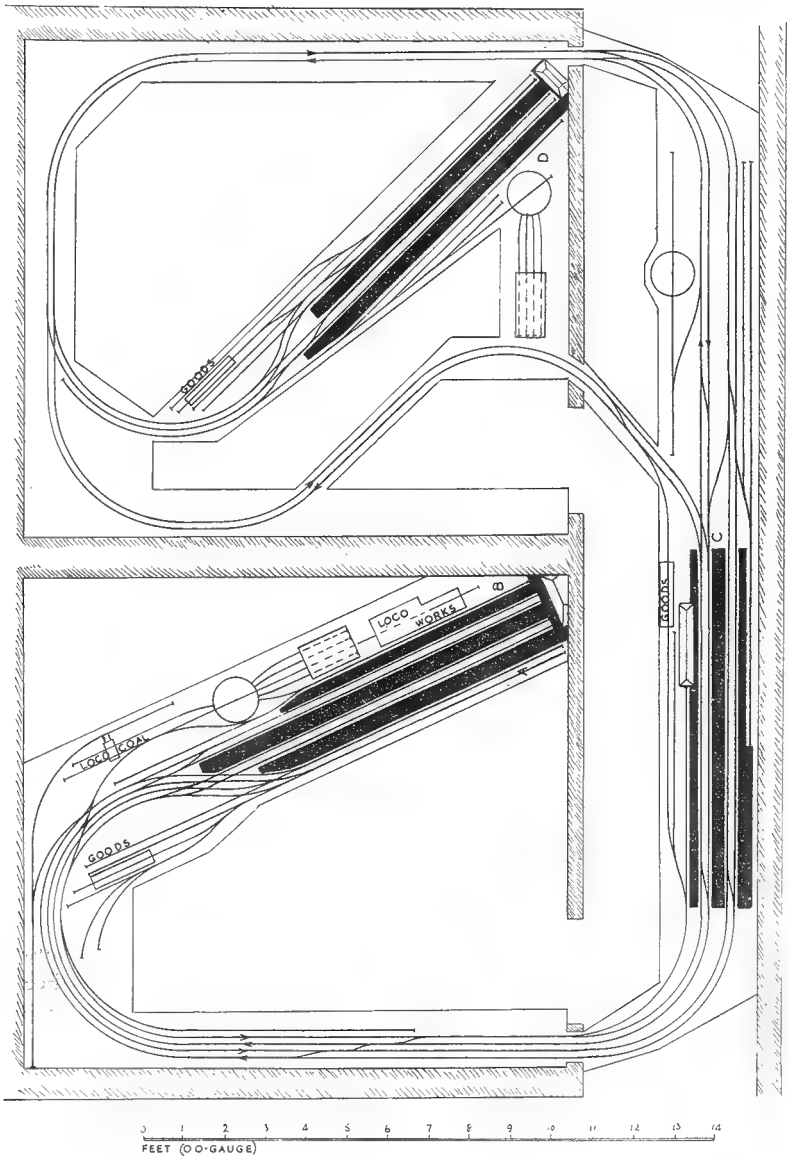
" The peninsula out in the river at the left top of the plan should be a decided ridge, explaining both the circuitous route of the mine branch and the tunnels of the main lines which pass through the ridge. In fact, the entire far side of the river is high country, with but a slight shelf along the river for the yards and trackage. The near-side of the river is more gentle, rolling country.

" The track plan sets no level of trackage, but instead all lines vary in level from point to point, one track going slightly upgrade, another down, so that at overpasses the difference in elevation is gained without excessive gradients."

A scheme like the foregoing is eminently adaptable to a large attic or stable loft, covering an area of 24 ft. by 23 ft. In the instance of a loft, there might be a good margin of space left for a small workroom. Invaluable also in Mr. Westcott's design are the excellent scenic details.

One other design, which shall be our last, was sent to me by a correspondent whose identity I have most unfortunately lost. I would particularly like to include it here, as it is conceived to occupy a couple of small adjoining bedrooms connected by a landing or passage. It would also most conveniently suit a couple of adjoining apartments in an office suite leading off a corridor, and for this reason may conjure visions in the eyes of some careworn business man who has such accommodation to spare. What a treat, to be able to shut up your account books, push aside your Income Tax forms, and, lighting your pipe, betake yourself to new and less perturbing occupations for an hour !

The plan is first-rate in its simplicity and conciseness, yet providing as it does some very interesting traffic conditions. The anonymous designer has tabulated these as follows :—



LAYOUTS FOR TWO SMALL ROOMS & ADJACENT PASSAGE

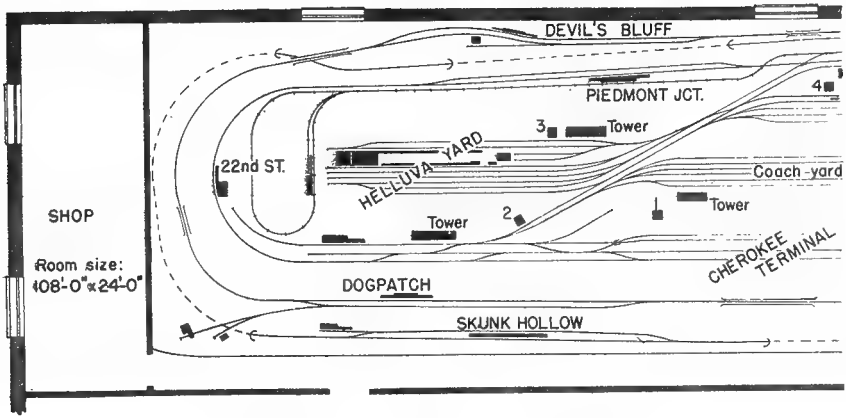
Down		*Up*
	Local Trains	
A to C		C to A
B to C		C to B
C to D		D to C
	(*The above are auto-trains*)	
	Long-distance Trains	
A to D	via C	D to A
B to D	via C	D to B
A to B	via C and D	B to A
	Non-stop Expresses	
A to B		B to A

The layout, it will be observed, differs from all others here discussed in that it possesses only one level throughout. The running arrangements are also different in their entire nature from the usual, and the scheme provides in every way a relief from the monotony which tends inevitably to mark the repeated efforts of an individual writer.

Having thus given our last working plan, there is one other which I will include on pages 66 & 67 with a view to showing the possibilities—whether in 0-Gauge or a smaller scale, this being in 0-Gauge–of a magnificent system for a very large site. This is the plan of the Atlanta Club, and it occupies the rented upper floor of a belting company's factory, the area thereof being no less than 108 ft. by 40 ft. It represents a point-to-point "steam" system and an electric "inter-urban" line, the latter being shown by hatched tracks. Gradients on the steam route are to a limit of 1 in 50, and on the electric route 1 in 25. Curves have a minimum radius of 6 ft. The track is two-rail and the voltage 16. On the layout there are 87 turnouts, including one double and one single slip. So much for the Great Southern and the Piedmont Traction Lines!

THE ARTISTIC FACTOR IN PLANNING

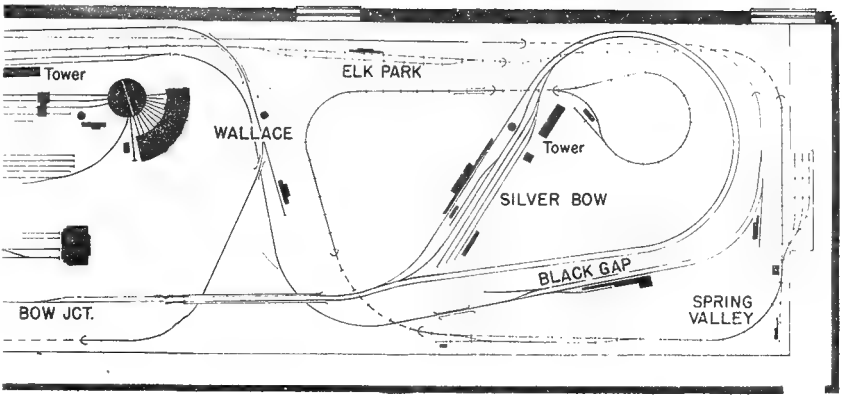
It is possible to plan a miniature railway with consummate technical accuracy, to avoid all those inconsistencies and incongruities to which the designer is liable, and yet completely to fail to produce a result that is persuasive and convincing in its realistic naturalness. The artistic factor in planning is, in short, both paramount in importance and elusive in character. Every effort should be exerted to produce a finished picture



ATLANTA CLUB RAILROAD

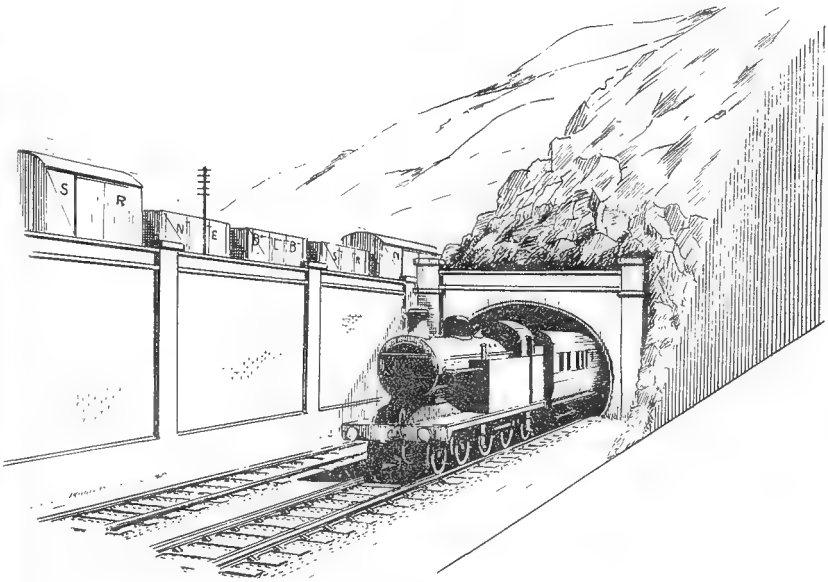
that will both please the eye and look the living part. It is here that the need emerges for the culture and exercise of the imaginative faculty. The designer requires to possess the gift of visualising the project before it is completed, whatever it may be, building up in his mind's eye the various structures and edifices which are to occupy the site, producing deliberately situations which shall be natural and imposing, or simple and life-like when finished. There are a hundred ways, for instance, of passing one railway track over another. It can be done in a very mediocre style and look most unreal and unlovely when it is done. On the other hand, it can be done in a manner altogether charming and—although mechanical—beautiful. One or two sketches are given on the following pages in order to show what I mean, though it is not claimed that they are themselves either artistically executed or entirely calculated to produce this effect. But they may serve their function. Further sketches depict certain corners of the layout illustrated in the first handbook of this series—entitled *Before You Begin*—one of them showing the attractive effect that may be secured by deliberately arranging a viaduct over the middle of a station, and others giving two approach views presented at bridges and tunnels on the main line. The purpose of these latter drawings is to indicate the meaning of the imaginative faculty in designing—the working out of the probable appearance of a location before it is actually constructed.

Above all else, next to accuracy, the designer of layouts should aim at neatness of finish, keeping things everywhere in their correct proportions in respect of dignity and relevance as well as of accurate scale appearance.

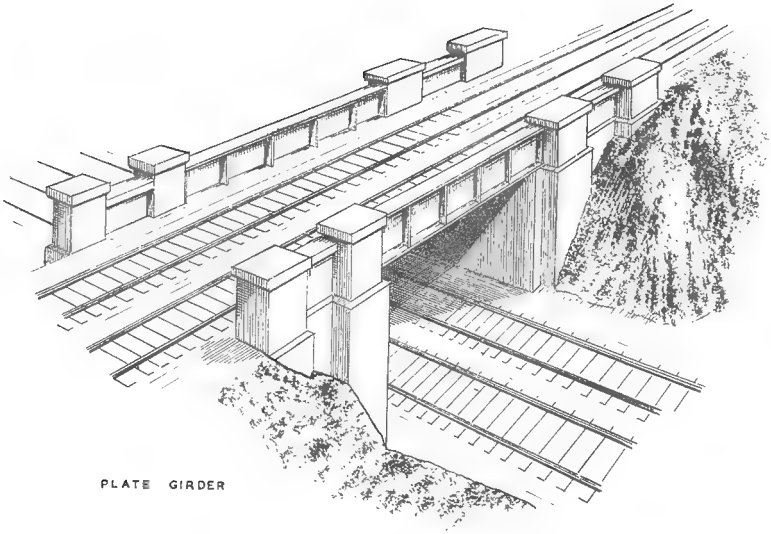


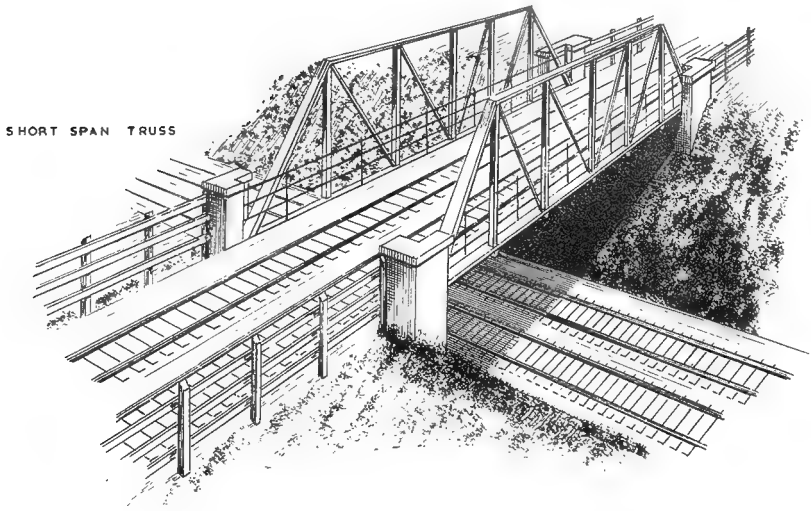
ATLANTA CLUB RAILROAD

It is here that the task of the model craftsman in great measure parts company with that of the railway engineer. Railways are engineered from the standpoint of necessity ; model layouts from the same viewpoint combined with that of convincing appearance.

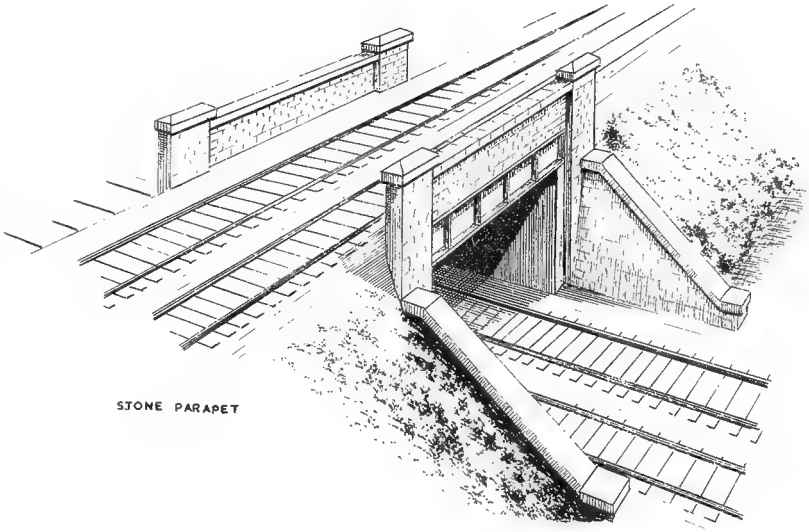


MIND PICTURE OF A TUNNEL AS PLANNED

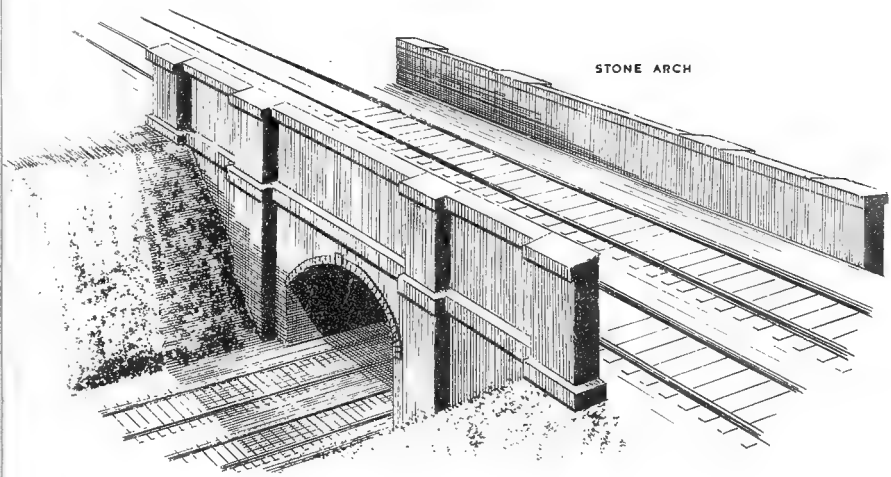




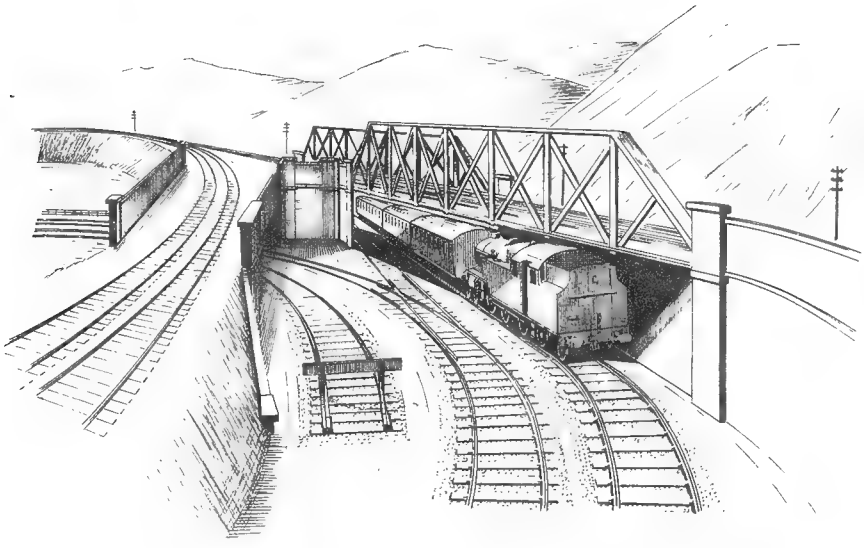
FOUR WAYS OF DOING THE SAME THING



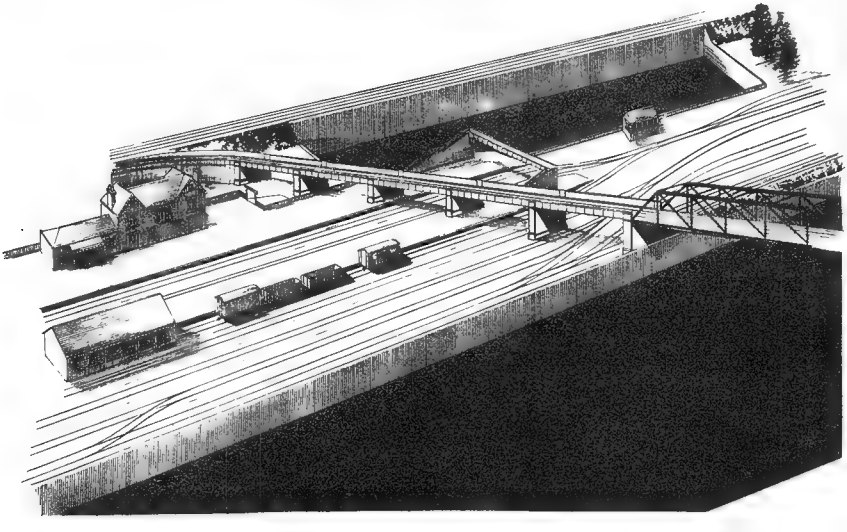
STONE PARAPET



STONE ARCH

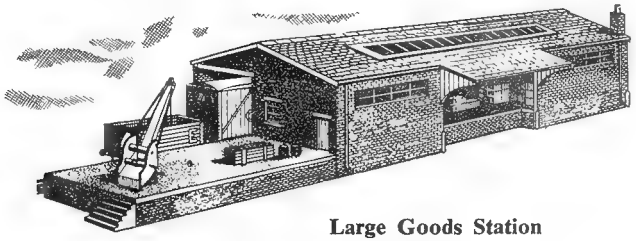


IMAGINARY VISUALISING OF A BRIDGE LOCATION



ATTRACTIVE EFFECT OF A VIADUCT SPANNING A STATION AREA

Lineside Kits



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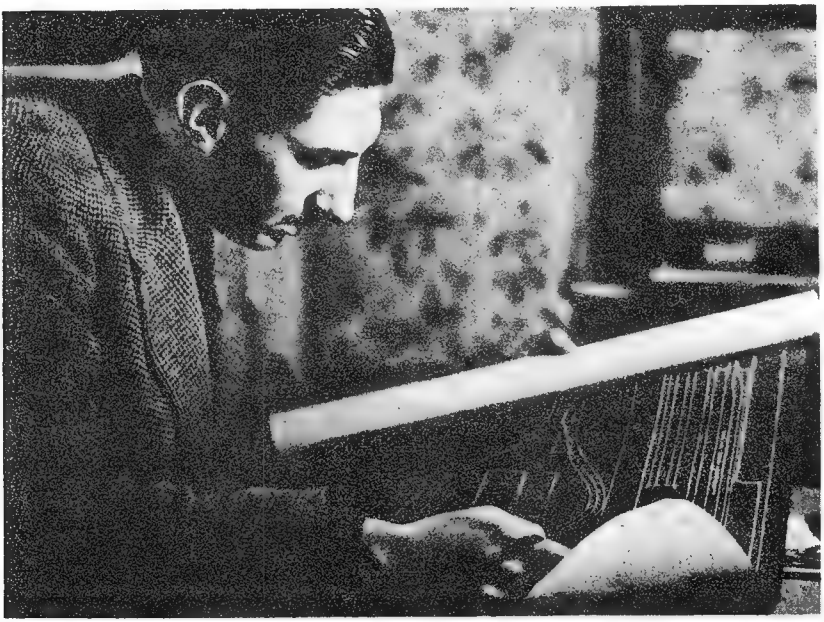


Mr. Fleetwood Shawe studies his diagrams. 'Photo A. D. Chappelow

CONTROL

POWER & CIRCUITS FOR MINIATURE RAILWAYS

A STANDARD model electric locomotive requires in the smallest working scale about one-half-ampere of current to operate it. The standard of motive power for 00-Gauge layouts has now been definitely fixed at 12 volts. " Volts " may be understood by the beginner to refer to pressure, and " amperes " as referring to the length of endurance of the supply. If you draw from a battery enough energy to run several locomotives for two or three days you will seriously exhaust it. But if you have the means to replenish that supply you can re-charge a normal-sized battery while it is running down, and can keep on using it indefinitely until either the water in it or the acid requires renewal.

The same degree of power (12 volts) will also serve to operate an 0-Gauge system, though most enlightened workers nowadays use a higher voltage in order to run heavy trains on more or less exacting gradients. Voltage is affected by gradients, dust and dirt and weight of trains.

The amperage of a power supply depends upon the means of recharging. If such means are at hand, and can be called into operation at any moment, the amperage will depend mainly—if not solely—upon the number of engines to be run simultaneously. Five to ten amperes will be more than enough. But if the batteries require to be removed for recharging the ampere-hour capacity should be higher in order to allow a longer length of life before recharging.

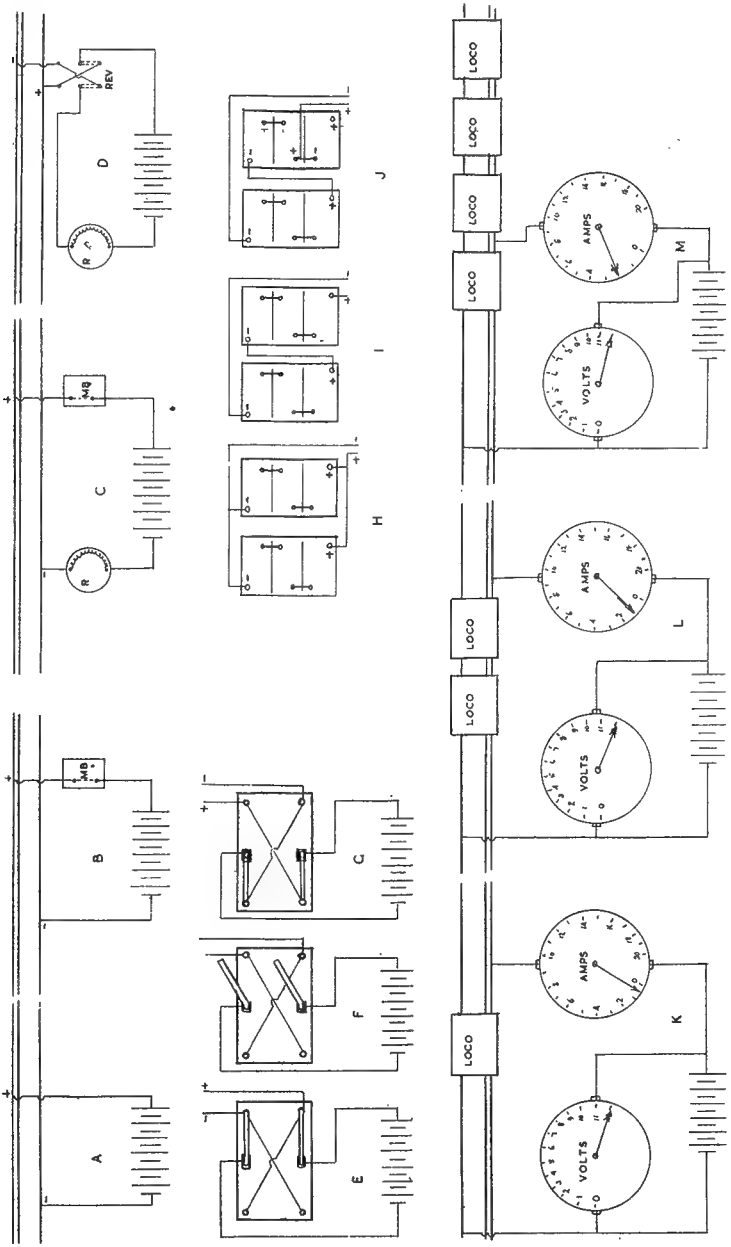
The required power could be had, within certain limits, from other sources than batteries or accumulators. It might be supplied from a dynamo or generator driven by an engine (steam or petrol or oil) or by a windmill. It may also be taken from the house mains through the medium of a charger or transformer to batteries, or it may be derived from the same house mains through a specially constructed power unit or " power pack " as the Americans would term it. The house mains may be either

Direct Current (D.C.) or Alternating Current (A.C.), and for either of these systems there is a suitable reducing agent—for D.C. a transformer, and for A.C. a transformer-rectifier. The first question to be decided in the discussion of propulsion is, therefore, the form which the power supply shall take. During recent years there have been many developments in the field, and some of the methods indicated have now become out-of-date. The battery had become the commonly accepted medium, and the plain motor-car battery at that. These appliances are strong and robust in structure and endurance, and if used with a constant means of recharging at hand they need not themselves be in the first-class condition of new car batteries. I will let you into a secret by stating that car batteries have been in use on the West Midland System for over 16 years—the same set—and they were " discarded " when first attached to the layout. But even the battery is rapidly becoming dated since the advent and subsequent perfecting of the power unit. In these days, batteries are extremely hard to come by, and since the required voltage has reached the minimum of 12, and since, furthermore, the accepted method of wiring requires two banks of 12-volt batteries, the power unit is likely in coming days to gain even greater popularity.

If you consult H, I and J in the first page of drawings you will there find three diagrams each of which represents two motor-car batteries. Each of the two is rated at 6 volts, 30 amps. In H, we have the two linked up in parallel so as to give 6 volts at 60 amps. In I, the two are connected in series so as to give out 12 volts at 30 amps ; and in J, the lower right-hand cell has been jumped, or excluded, so that the output is 10 volts at 30 amps. It will thus be clear that such batteries can be so manipulated as to provide almost any voltage and amperage required.

Power units are now so designed as to give a choice of various voltages and an alternative between series and split-potential supply (of which more will be said shortly) at will. It is simply a matter of plugging the leads into different holes. There are numerous types on the market, both British and American, the famous Shenphone make being happily once more available.

Before leaving the first sheet of drawings, consider A. This is the simplest form of circuit for a track, and is shown without controls. It is known as the series or one-battery system, the positive lead being taken from the battery to the outer conductor or third rail, the negative lead to the running rails. In B we have the same circuit with a make-break switch introduced for a measure of control. It can now be switched in or out. In C, a further switch appears—a resistance or rheostat—(R) and this is



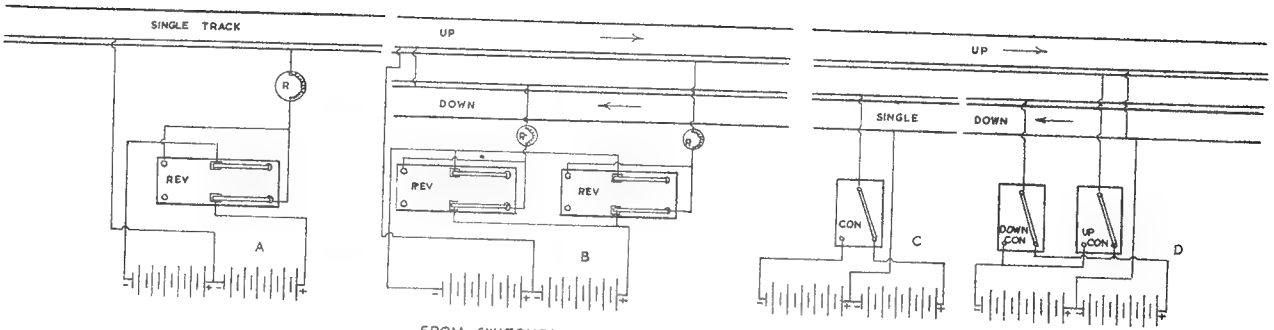
ELEMENTARY LOCOMOTIVE CIRCUITS

used for reducing or increasing the power, and thus affecting the speed of the engine. In D, with the same series circuit, we have introduced a double-pole-double-throw knife switch to act as a reversing agent, the reversing being achieved by the method of wiring up to the switch. It will be seen by the novice that simply by crossing the terminals the positive element can be, as it were, thrown into what was formerly the negative wire to the track, and *vice versa*. The engine thereby receives the positive through the wheels instead of through the conductor rail, and this reverses the direction of the motor. When the knife switch is located at the half-point the current is off; so we have dispensed with the make-break switch as redundant. We are now able to start, stop, reverse and control the speed of the locomotive.

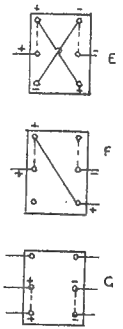
The three positions of the knife switch are shown in E, F and G; E is forward, F is off, G is reversed.

Most beginners are anxious to know how many locomotives can be run at one time with a stated voltage and amperage. K, L and M will give details as to how the current is affected by the number of engines running. In K, we have a single engine and below it a voltmeter and an ammeter. The running of the engine makes no difference to the voltage (excepting the gradual exhaustion of it through time), and (as the ammeter shows) takes about half an ampere. In L, we have two locomotives in service. The only difference now is that instead of a half-ampere we are using a whole one. In M, with four engines in use, the voltage is still unaffected, save that the drain upon it will be fourfold (depending upon the condition of the motors), but the amperage is at two. So, therefore, as many engines may be run on the same voltage as the amperage will permit.

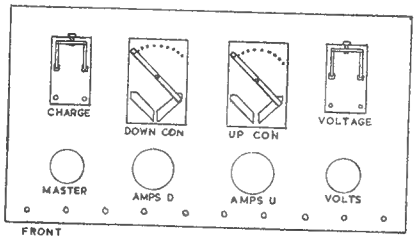
We will proceed now to the second page of drawings, considering A, B and C. We have thus far been dealing with the simple series battery, or "one-battery" method of supply. I want to indicate the manner in which the more acceptable "split potential" or two-battery supply system is wired, and the manner in which the universal controller substitutes all the separate switches that were formerly popular. It will be seen in A that in place of one battery of 12 volts, we now have two, and that they are so wired up—one lead from the inner ends of the batteries to the running rail, and two other leads from the respective outer ends to the switch—that by the manipulation of the switch either of the batteries is selected at will and brought into use, to the exclusion of the other. This selection of the battery depends upon what direction the train is to travel—backwards or forwards. By throwing the switch, positive rail becomes negative rail,

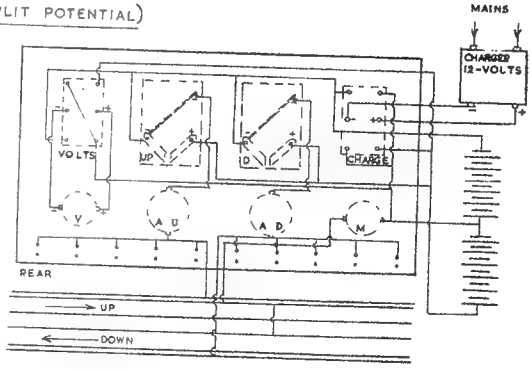


FROM SWITCHES TO CONTROLLERS · (SPLIT POTENTIAL)



WIRING REVERSE SWITCH





COMPLETE SWITCHBOARD WITH REVERSE SIDE CONNECTIONS

A-C MAINS TO DOUBLE TRACK

one battery being substituted for the other. The resistance switch is necessary for the speed control. In this diagram we have one track only; but in B we have introduced both an " up " and a " down " track. That means two switches, one for each road, and two resistances. Note that the batteries are not selected one for the " up " and one for the " down " roads, but according to the *direction of travel on either road*, so that sometimes both roads may be using only one of the batteries, the other being out of use. Now, in C, we have made a change by introducing controllers in place of separate switches. The first diagram refers to single track, the second to double. It will be seen that for single track, one controller does all the work, under one lever and one movement, of make-break, reversing and speed control. The construction of this controller will be described later, when it will be indicated how these various tasks are executed. It may be taken for granted, however, that the scheme of C and D depict the best and most generally approved method of power transmission to miniature layouts.

It should be mentioned that the double-pole knife switch has its accepted uses on a switchboard, though these may not apply to current supply to tracks. It lends itself to a variety of wirings, to the discussion of which we will later return.

At this point, however, in order to give the beginner the conviction that he has covered the elementary ground and has arrived at something in the way of practical knowledge, we will describe a small standard switchboard, which is depicted in the next two diagrams, one of which shows the front side and the other the rear side of the board, with all connections. On the front side we have a knife switch (double pole) for use in charging the batteries from the mains, one position throwing the charger into service with one battery, the other position charging the other battery. On the opposite side we have another knife switch which is so wired as to throw in the power from either one of the batteries to the voltmeter, in order that an instant reading can be taken of each battery's condition. Below these, we have first a master switch of the ordinary make-break type which cuts out or puts in the entire railway supply, so that on leaving the layout, the operator can be sure, having thrown the switch, that everything is perfectly safe. Next we have two ammeters, one for the " up " and one for the " down " road. Finally, we have the voltmeter for the whole layout.

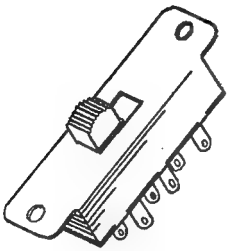
The reverse side of the switchboard is next shown, and this drawing should at this point be thoroughly studied and mastered. Note that the main leads pass through the charger, which has an output of 12 volts. From the charger, the leads pass to the charger switch (centre terminals),

being taken from one end of the switch to one battery and from the opposite end to the other. From the batteries, the controllers are next wired exactly as shown, the lower two terminals to the battery, the upper single terminal to the ammeter and from this to the respective track and the small section switches along the lower edge of the board. These latter switches are of the low-amperage tumbler variety. The voltmeter switch is independently wired, and must have the positive lead and the negative lead attached to their correct terminals. It is assumed that the track used with the third rail is of the all-metal kind; and if it is not, the two running rails must be bonded together, as shown.

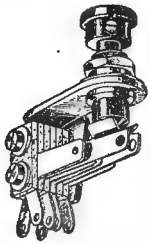
The beginner has now virtually covered the whole of the elementary ground to the point of knowing how to supply power to the main tracks of any layout on the split-potential system.

A few words might be written concerning transformers, rectifiers and chargers, if these are to be used. The writer has found the best appliance for use with A.C. mains to be an Ediswan Trickle Charger providing from 6 to 12 volts D.C. output, and has had one of these machines in service for almost 20 years. There are, however, many standard appliances on sale commercially, and the only caution required, perhaps, is to see that the appliance is suited to the voltage required. It must be observed that a D.C. output is absolutely imperative for the usual type of locomotive motor supplied, though many owners are now running engines in 0-Gauge fitted for A.C.

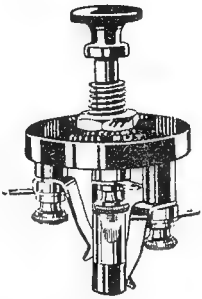
We may turn back briefly to the diagrams on page 5 showing the three wirings of the knife switch (reverse switch so-called). The wiring for reversing is shown in E, where the four terminals are simply crossed. In F we have the crossing of only two of the terminals for use with the voltmeter. In G, we see the connections for use with the charger. This same switch has its uses in other situations on a layout—for reversing current in connection with certain points, for the operation of signals, and so forth. An earlier and quite reliable form of double-pole-double-throw switch is shown in the constructional drawings. This is useful in that it can easily be made by the amateur himself and will serve all the purposes of the knife switch.



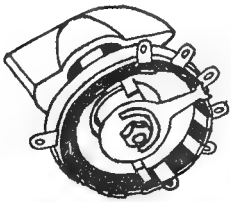
SLIDE SNAP (*M.R. Controls Co.*)



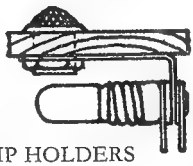
PUSH KEY
(*Walthers*)



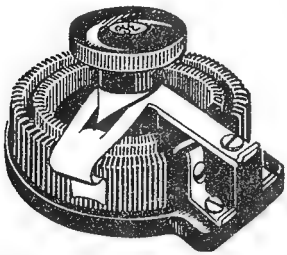
PUSH PULL
(*Walkers*)



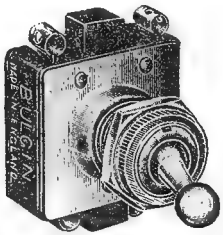
ROTARY TAP SWITCH
(*M.R. Controls Co.*)



PILOT LAMP HOLDERS

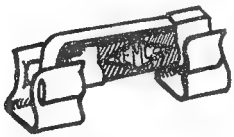


RESISTANCE SWITCH
(*Pioneer Co.*)

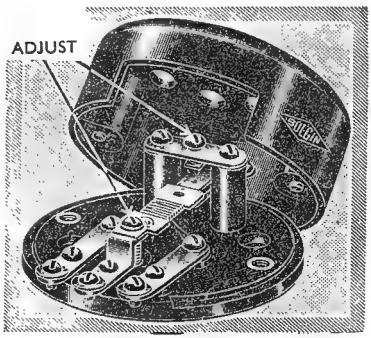


DOUBLE-POLE M.B. TOGGLE
(*Bulgin*)

PUSH BUTTON (*Bulgin*)



THERMAL CONTACT BREAKER
(*M.R. Controls Co.*)



THERMAL SWITCH (*Bulgin*)

RECOMMENDED SWITCHES

CONTROL

SWITCHBOARD AND TRACKSIDE SWITCH APPLIANCES

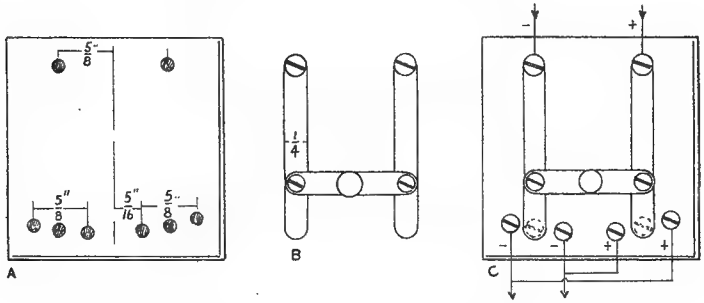
For Switchboard Work. A simple switch for make-break work is the common single-pole knife switch similar in type to the double-pole example described, and this is useful in a variety of ways. Ordinary tumbler switches of the midget kind are also excellent, the smaller the better; and the push-pull plugs so common before the war are invaluable for section switches on a switchboard. These plugs could also be had with three, four, five and six poles, and were most acceptable in all these forms.

The possibilities of the American market should not be overlooked by the prospective switch buyer. The sending of small amounts of money to America should soon, we believe, be permissible, and the lists of American manufacturers certainly offer great attractions in the matter of the commoner instruments such as are unobtainable here at present. Small toggle switches, or tumblers, plugs, resistances, relays in the greatest variety, as well as reversing switches of all kinds, can be had. Walthers can supply handy little press-button switches which are indispensable for the operation of point machines and so forth. Bulbs for the switchboard or other purposes are plentiful in America.

There should be either an automatic cut-out or a fuse on the switchboard for the purpose of saving the batteries and preventing damage to power sources by reason of short-circuits. The fuse is a great nuisance, and the cut-out does the work without requiring to be rewired each time it operates. Cut-outs can be had from Walker & Holtzapffel Ltd., or from Shenphone

Resistance switches are difficult to obtain, and very few commercial types are suitable for railway supply. There is an excellent example on sale in America, of the twist-knob sort, having asbestos-sheathed coils; but the price is somewhat high. The original use for these was in connection with radio, and the exploration of radio stores might unearth a few. The elimination of the need of unsatisfactory resistances is one of the main advantages of the use of a controller.

Apart from the common knife switch described, much the same may be said of reversing switches, especially in these difficult times. Unfortunately it is often necessary to instal these appliances, and there are indeed

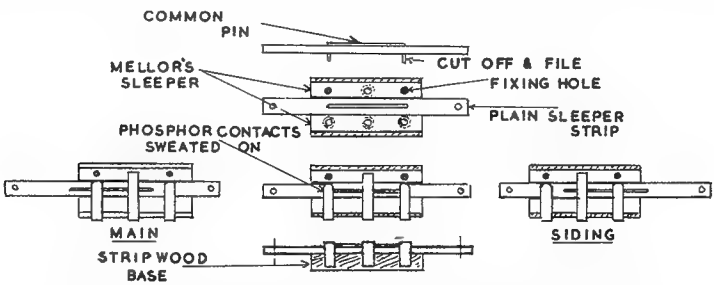


EARLY AND RELIABLE TYPE OF REVERSING SWITCH

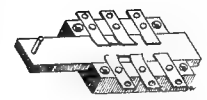
one or two fairly good commercial types. A sound scheme is to make them oneself. The diagram above shows how to do so.

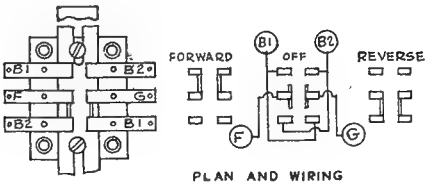
Ammeters and voltmeters can often be had from scrapped cars, or from a junk yard, and these will admirably serve the purpose. It is necessary to note that there must be a separate ammeter for every controller employed on a layout, the function of the ammeter being not only that of indicating when short-circuits take place, but also that of revealing at once the amperage in use or at disposal. With the split-potential system a separate ammeter *must* be wired into the circuit of each of the two sets of batteries.

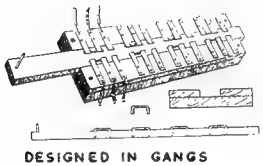
For the Trackside. Some of the most essential electrical appliances in miniature railway work are those which require to be placed on the track itself. An example of these is Walthers' tie-rod (or point-rod) switch, which the writer has often recommended before. The cost of this appliance is really negligible, but its uses are legion, and it is a soundly constructed, reliable little mechanism. Various illustrations of it, and suggested adaptations, are given. A plan of the switch, with its wiring as a power-operated reverser, is shown, as well as a perspective sketch. But apart from its use as a reverser, it may be employed as a section switch, as a signal



AUTHOR'S SIMPLE SCHEME FOR A SECTION SWITCH





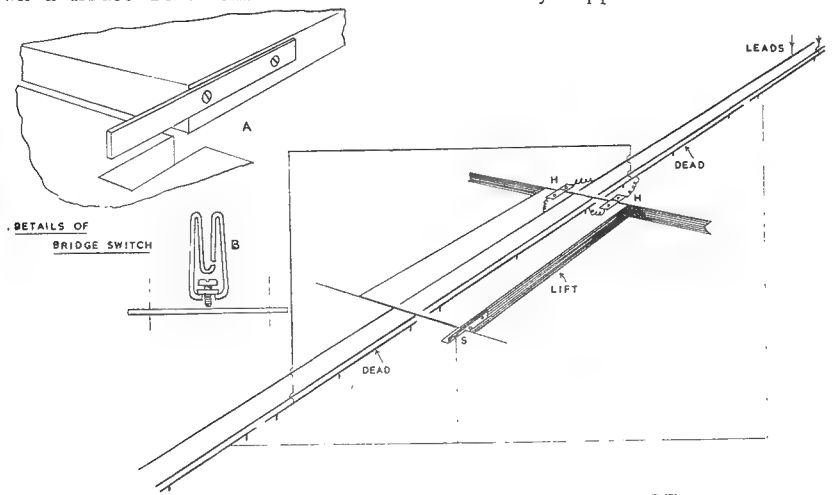


WALTHERS' SECTION SWITCH

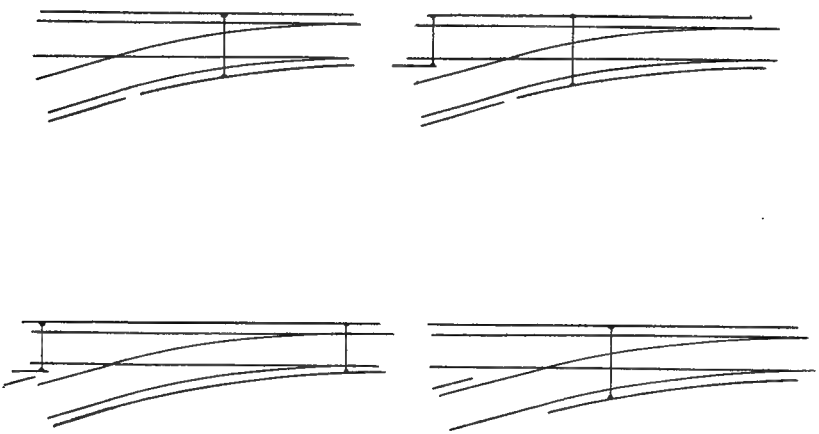
WALTHERS' SECTION SWITCH

operator attached to a lever on the switchboard, and as an automatic selector for all manner of purposes ; and it can also be used in its commercial form as the attachment on a point machine to be used as a relay.

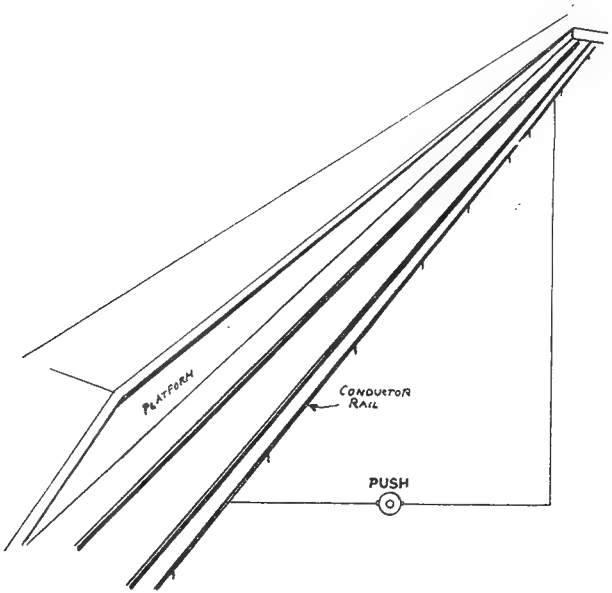
A relay is actually an electrically-operated switch with either single-, double- or multiple-poles. These poles or contacts are usually formed of light flat springy material such as phosphor-bronze, and the principle on which the relay operates under power is that of the electro-magnet as used on a house bell. An excellent article on relays appeared in the *Model*



ELECTRICAL CONNECTIONS AT LIFT BRIDGE

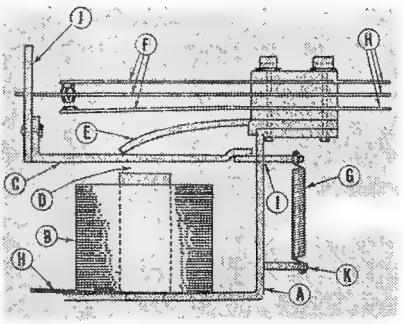


VARIOUS POSSIBLE CONDUCTOR ARRANGEMENTS AT A COMMON TURNOUT



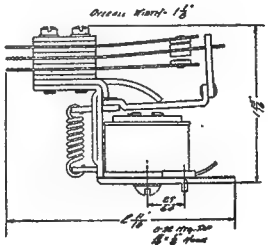
TRACK ENDS AT END OF PLATFORM

Railroader for September, 1944, and I am indebted to this article for an explanatory drawing which will make perfectly clear the mechanism. Here, A is the frame, B the coil, C the armature, D the air gap between armature and core, E the armature back-stop, F contact springs, G the return spring, H terminals, I the armature pivot and J the lifter bar. When the coil is energised the armature is attracted to the core, taking along with it the lifter bar, and this causes the contact with the upper spring to be broken while contact is made with the lower spring. When current is released, the return spring pulls the armature back against the back-stop and sets the contacts in their normal position. It will therefore be seen that the circuit operating the coil has set switches and thus controlled current in another and a separate circuit.

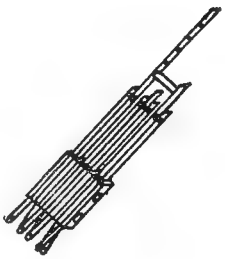


MECHANICS OF A RELAY

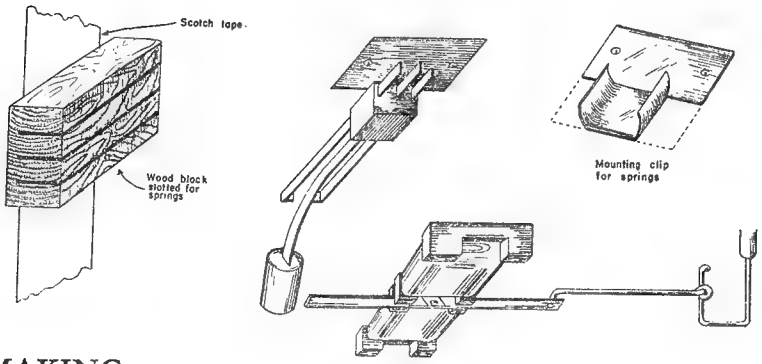
Innumerable are the usages on a layout for relays, especially in connection with electric signals, and the sooner the amateur masters the principle of the relay the better. They are by no means the complicated and perplexing machines they are often imagined to be, and their use adds enormously to the smooth manipulation of power on a layout. It is quite easy to make relays, and on page 14 the details for such work are given. In this instance, for the use of which I am obliged to the *Model Railroader*, the relay is intended for use along with a switch machine as its energiser, the switch machine being fitted beneath the baseboard. The main feature of the relay is the wooden block notched with a saw to receive the contacts. These are



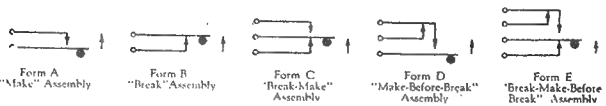
COIL-OPERATED RELAY (*Walthers*)



RELAY CONTACT ASSEMBLY
(*M.R. Controls Co.*)

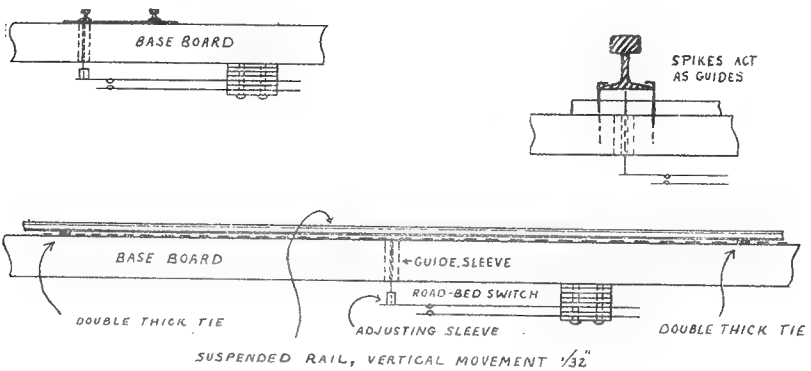


MAKING A RELAY


Form A "Make" Assembly
Form B "Break" Assembly
Form C "Break-Make" Assembly
Form D "Make-Before-Break" Assembly
Form E "Break-Make-Before Break" Assembly

SPRING ACCESSORIES

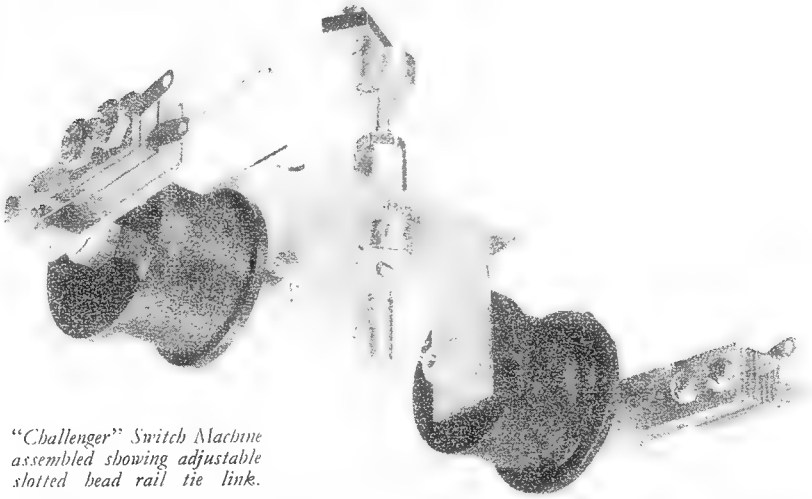
a tight fit in the notches, and they are wrapped with insulating tape. If so desired, layers of fibre may be used for the contact-binders, the whole being bolted together with bolts similarly wrapped or sleeved in insulation tube. This little structure can be applied to any form of relay such as that already illustrated, or to the Walthers' type also shown.



PIONEER ROAD SWITCH

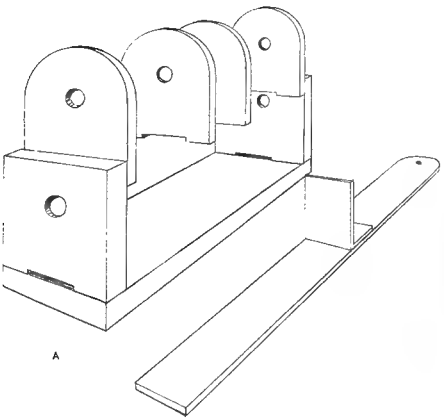
Another useful switch for the trackside is the thermostat switch. In this machine the function is that of a delayed-action movement induced by graduating heat. Otherwise it is a plain form of relay. The operating circuit in this case passes around an asbestos sheathing which covers an armature made of two strips of metal, the one strip of steel, the other of copper. The copper expands under the heat much quicker than the steel, causing the two-metal contact to bend over or kink to one side and form the relay contact. A diagram for making this apparatus is given on page 42, and there is nothing difficult about its construction. A good commercial type is sold by Bulgin & Co. There are several uses for such a switch on a layout, notably that of delaying the operation of a train for a few moments after the electric signal has been pulled off, and thus avoiding that eccentric and unrealistic starting of a train the instant the signal falls.

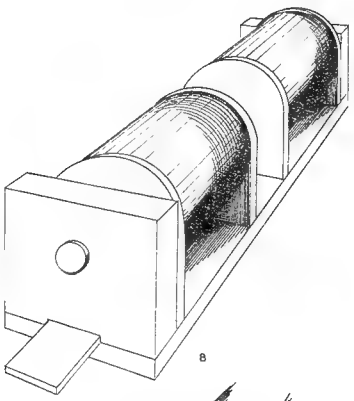
The ideal method of point operation for any degree of distant control is that of the electric point-machine, many varieties of which are on the market. In Britain, we have the Shenphone, the Zenith, the Bond and others, all of which are good. There are also many extremely efficient American examples, the Challenger and others, and the Walthers' type I have personally found to be a machine which will operate when all others I have tried give up the attempt. I have operated a Walthers' machine on six volts where every pre-war type has refused to work on 12.



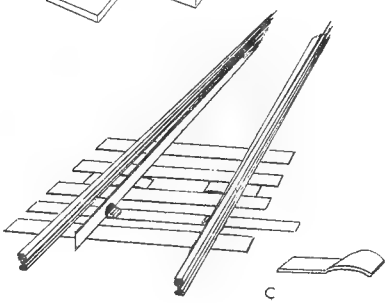
"Challenger" Switch Machine assembled showing adjustable slotted head rail tie link.

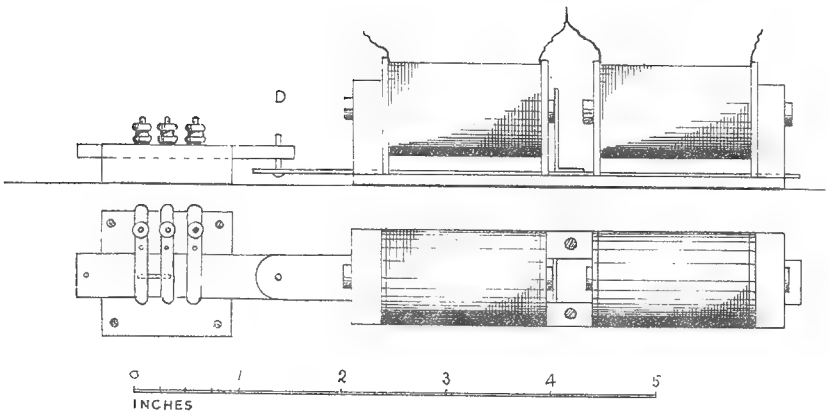
A thoroughly workable point-machine can be made by the amateur in the manner of the next diagram. The first sketches show the wooden foundation of the appliance, and the machine as it appears when assembled.





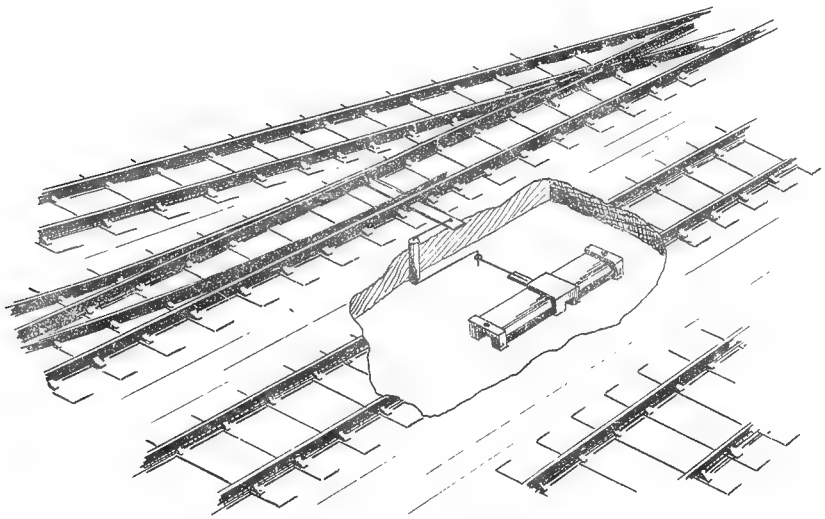
MAKING A POINT MACHINE





Note the two slots at the base of the outer frame, to receive the sliding armature, as well as the other notches in the bobbin ends. Iron bolts are slotted through the bobbin ends and through a cardboard core to insulate

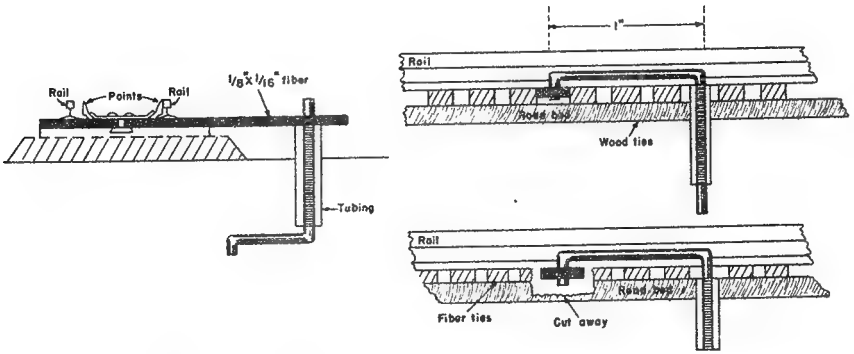
them from the wire. Bobbins should be wound with as much No. 26 double cotton-covered wire as can be got on, and should have the winding done accurately and tightly. The starting and finishing ends of the wire should be left projecting. The sliding bar is then prepared, being a length of shaped brass strip having a phosphor-bronze contact midway, a hole at one end of the bar. Make certain that this slides freely through the apertures, and build up the machine with glue and screws.



LOCATING POINT MACHINE BELOW BASE

While we are describing this machine it may be as well to include along with it a suitable selector switch on the principle of Walthers' tie-rod switch. Here, however, the appliance has only three contacts in place of six. It will be possible by adding this little device to convert the switch machine into an effective relay for all manner of purposes, while still retaining the qualities of the point operator. It will be seen that by using this selector, current can be controlled in a variety of ways. The terminals used can be stripped from an old plug switch. Contacts are of phosphor-bronze. The base may be of wood or fibre.

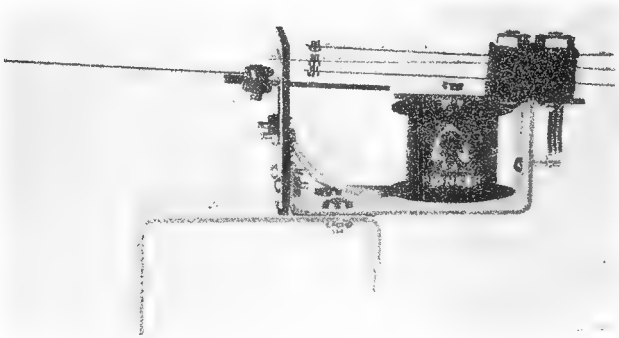
There is only one snag to the use of this home-made machine—it is not positive in its action to the extent of retaining the point blades in a locked position when thrown. It is therefore necessary, whenever it is used, to apply to the points a device like that shown in the sketch, two small clips being soldered one under each stock-rail. In this manner the point will stay in place when thrown.



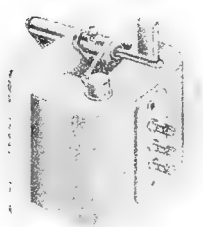
POINT ROD WITH DETAILS OF CHAIRED TRACK

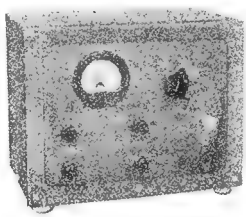
Certain of the American machines can be bought in kits, such as the Challenger machine produced by the Pioneer Company of Chicago, and the excellent Indian Head Switch-Machine Relay by the same manufacturers.

The wiring up of a switch machine is quite straightforward. The inner lead from each of the two coils is wired to its neighbour, the two outer leads being left as they are. The inner ends are then connected to the common return wire of the circuit.



Photos (*above*) *"Indian head" Relay Switch Machine assembled.*
(*below left*) *Zenith Point Motor.* (*below right*) *Shenphone Power Unit.*





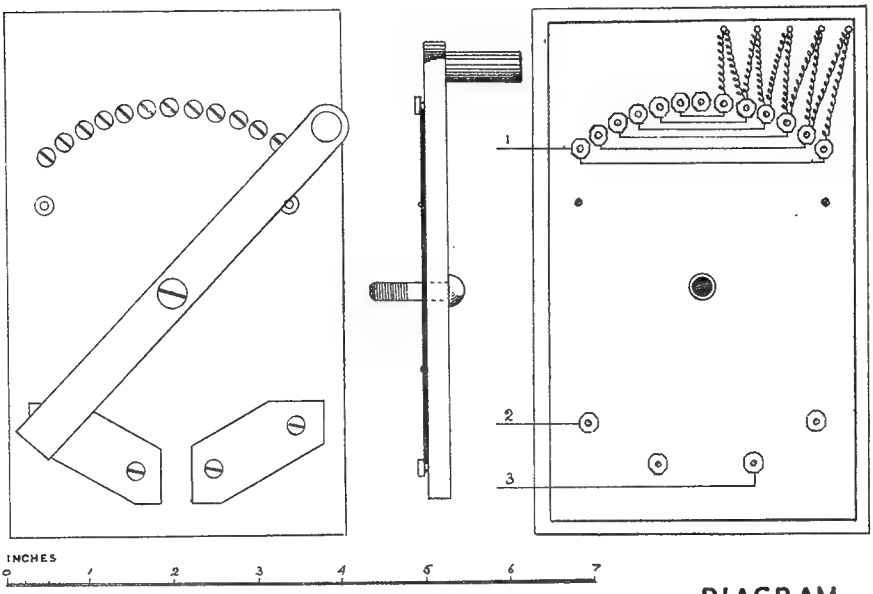
CONTROL

SECTIONAL CONTROLLERS

The controller is the mechanical brain of the system and deserves some careful discussion. In the first place, a controller is needed for every section of the layout, up and down, large and small. And while there must be as many sections as correct working demands, it is therefore wise not to multiply the number of such sections ruthlessly. There are instances where, in the case of a yard or siding, these may be operated off the main controller for that neighbourhood. Yard plugs may be introduced on the switchboard, served under the main controller, as indicated in a diagram. on page 23. But even then the preferable scheme is shown in the next drawing, where a separate controller is used. If, for instance, you wish to be able to run main-line trains into a platform while the adjacent station yard has other manoeuvres afoot, there is nothing for it but two controllers, one for the mains and the other for the yard. If it is a couple of sidings out in the country, then the plugs might conceivably be substituted.

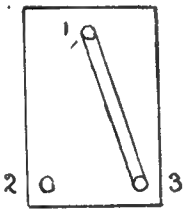
Another important question is that of the right place to fit controllers—whether all together on the main switchboard, or at various points of the layout according to sections, or separate controllers from the main board only to be fitted adjacent to station yards. The answer to these problems is to put controllers always where the operator has the best view of the section to be manipulated. It is worthy of note that if controllers are located all over the place, the operator will never be off his feet. Whereas, if they can all be fixed on one central position, then the operator can work while seated, and certainly the movements at outlying points will have a greater degree of realism.

The best controllers are probably those that are made by the builder himself; there is nothing whatever difficult about the task, and the cost of the materials is very low. A design is therefore given for a split-potential instrument which can be duplicated at great convenience when once the first is made. It will be seen that it consists of a 4-in. by 6-in. wood block—the size is quite immaterial and it may be smaller if desired—which is fitted with two shaped brass contact plates attached with countersunk bolts, a row of cheese-headed brass bolts at the top, two lever stops, and a wooden lever with contacts behind it. The lever and block are drilled for a $\frac{1}{4}$-in.



SPLIT POTENTIAL CONTROLLER

DIAGRAM FORM



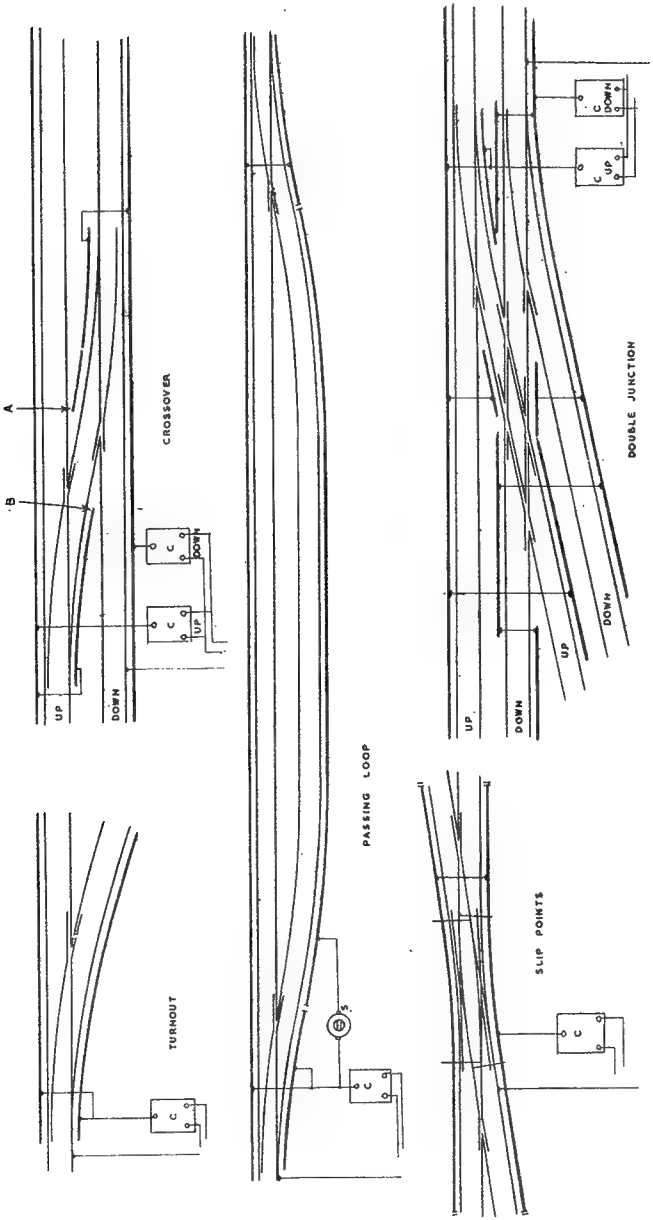
bolt about the centres. Here may be mentioned a further advantage of the split-potential system—that controllers are much more easily made for this scheme than for the series method. Observe that, on the reverse side of the block, the contact bolts are linked together with wire as shown, the middle one being left neutral for a stop position. The lever stops are formed from angular cup-hooks broken off and filed. The resistance wire is attached as shown, and the length of it and capacity are best judged by experiment. The capacity should be such that the movement of the lever contacts over every stud makes a decisive difference to the speed. There are three terminals on the controller, two at the base and one at the top ; these are connected as shown in earlier diagrams, and the diagrammatic form of the controller as shown at the side of the reversed block. Note that the hole for the pivot in the block should be bushed with brass tubing, and the screw studs on lever should be lightly filed to ensure easy wiping over the contact studs.

CONTROL

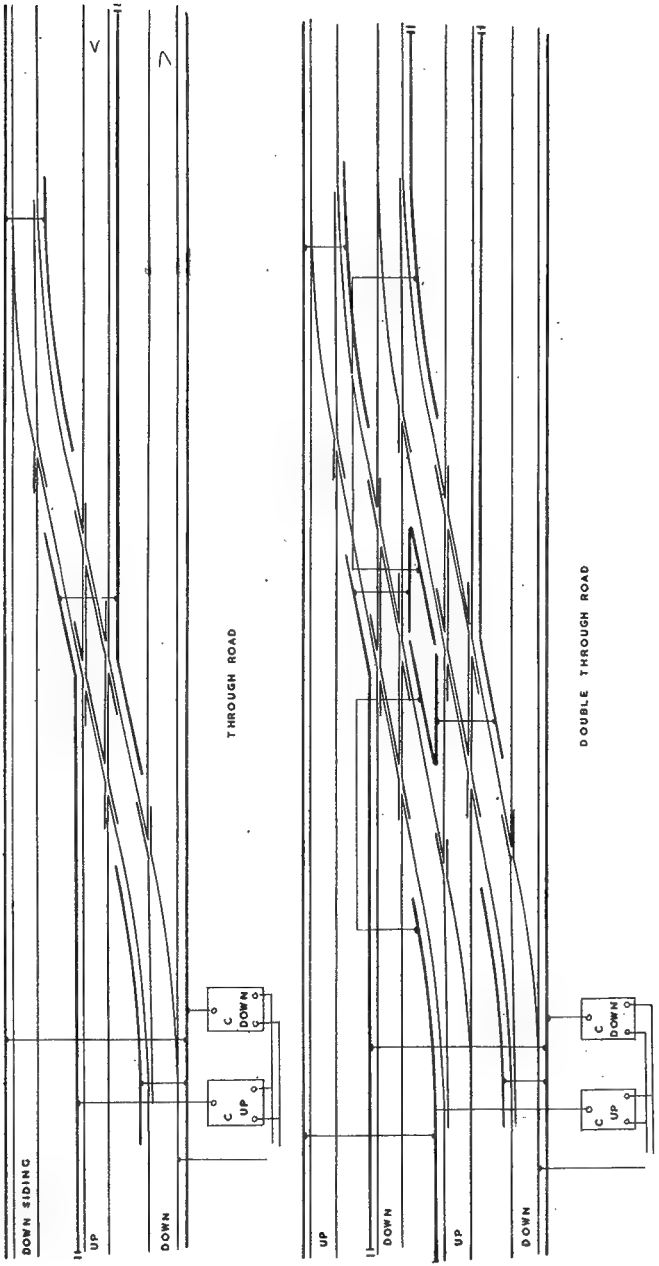
THREE-RAIL POINT WIRING

There are many ways of placing the conductor rail which carries the positive element related to the negative element of the running rails, much depending upon how the conductor has been laid along the main line and sidings. Four alternative possibilities at a common turnout are shown in diagrams on page 12. The same alternatives may occur at cross-overs and junctions. Let us, however, turn to the page of drawings describing actual wiring, and consider the simple turnout. These drawings will be found on page 22. First, the turnout is shown with its conductor wired correctly so as to supply current to the conductor rails and running rails of the main line and siding. It is assumed that the whole of the running rails on the entire layout are bonded together as one element, only conductor links being shown. Trains will here run in either direction according to the position of the point. In the instance of the crossover (next diagram) we have up- and down-roads and therefore two controllers. It will be noticed that the inside sections of conductor rail are wired one to the up- and one to the down-road. With the precise arrangement of conductors shown in the drawing there would be slight trouble. The collecting shoes on the engines, which serve to take up the element of current from the conductor rail, would, when passing along, say, the up-road, catch the end of the down-road inside conductor rail after passing the frog. This would cause momentary short-circuit. It is therefore necessary to see that the ends of conductor rail in such danger are not carried quite so far, but break off short of the collector's reach. The two points of danger in this drawing are marked A and B. In the case of the passing loop we have precisely the same arrangement as with the plain turnout, excepting the fact that the loop section of straight road is severed from all the rest (conductor rail only) and can be energised or de-energised at will by pressing the button S. If desired, a tumbler switch can substitute the press-button. This arrangement enables a train to be stopped while in the loop track while a main-line train rattles past on the main, and it constitutes our first introduction to sectionalising.

Strangely enough, the slip point is about the least complex of all points to wire up for three-rail supply. All that is necessary will be the



POINT WIRING



POINT WIRING

two sides of conductor rail, and unless there is to be a mixture of up- and down-road traffic passing over the slips there will be no need even for the breaks at the ends of the conductor, which isolate the slip-point power from that of the main lines. The double junction is a little more complicated, though it involves no unusual snags.

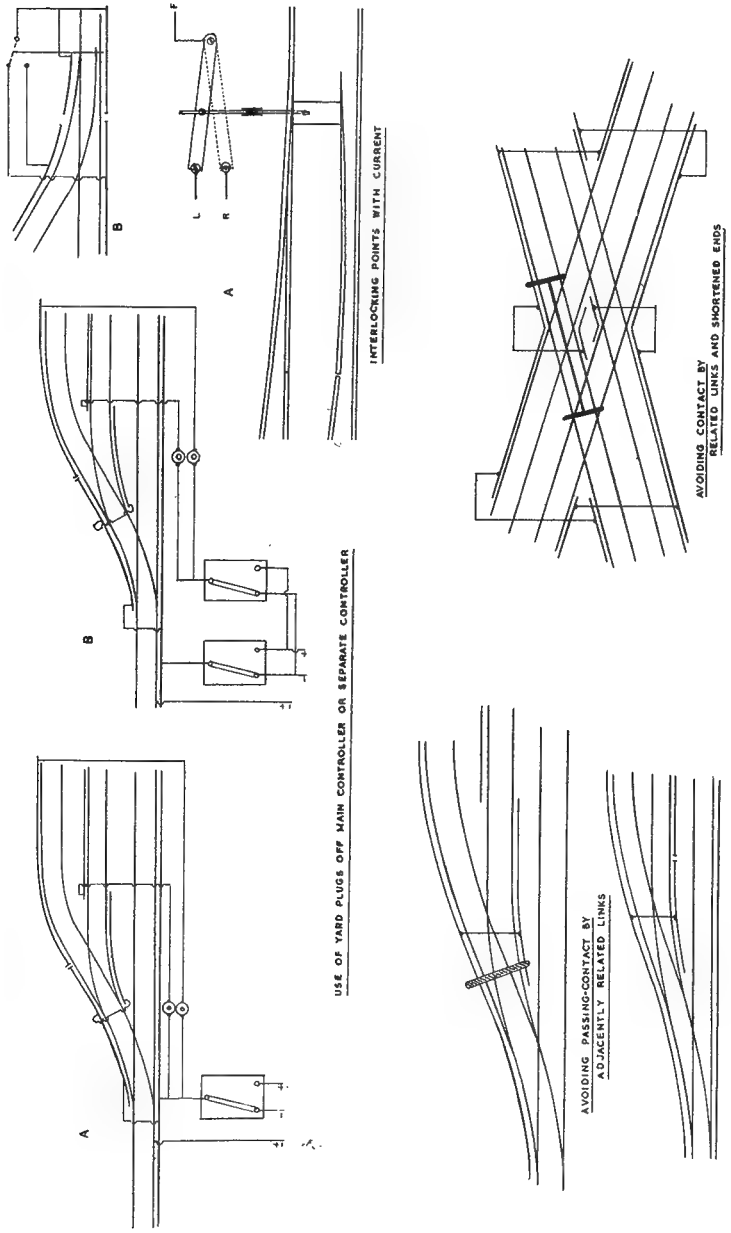
The through roads, single and double, of the next drawing, are rather more interesting. The single through road, passing from a down-main, through an up-main to a siding, or to a third down-track, is such as might occur at docks or industrial sites, or even at passenger stations. If it is desired to have stationary traffic on the siding while the lower (down) road is in energy, a tumbler switch will require to control the siding separately. The up-road is isolated, as shown at the ends, and if the isolated sections are extended to cover about double the length of an express engine on each side of the crossing, the up trains will have space to stop themselves automatically, should the through road be in service. But for this purpose section switches must be arranged on the point rods to cut out the safety sections of track.

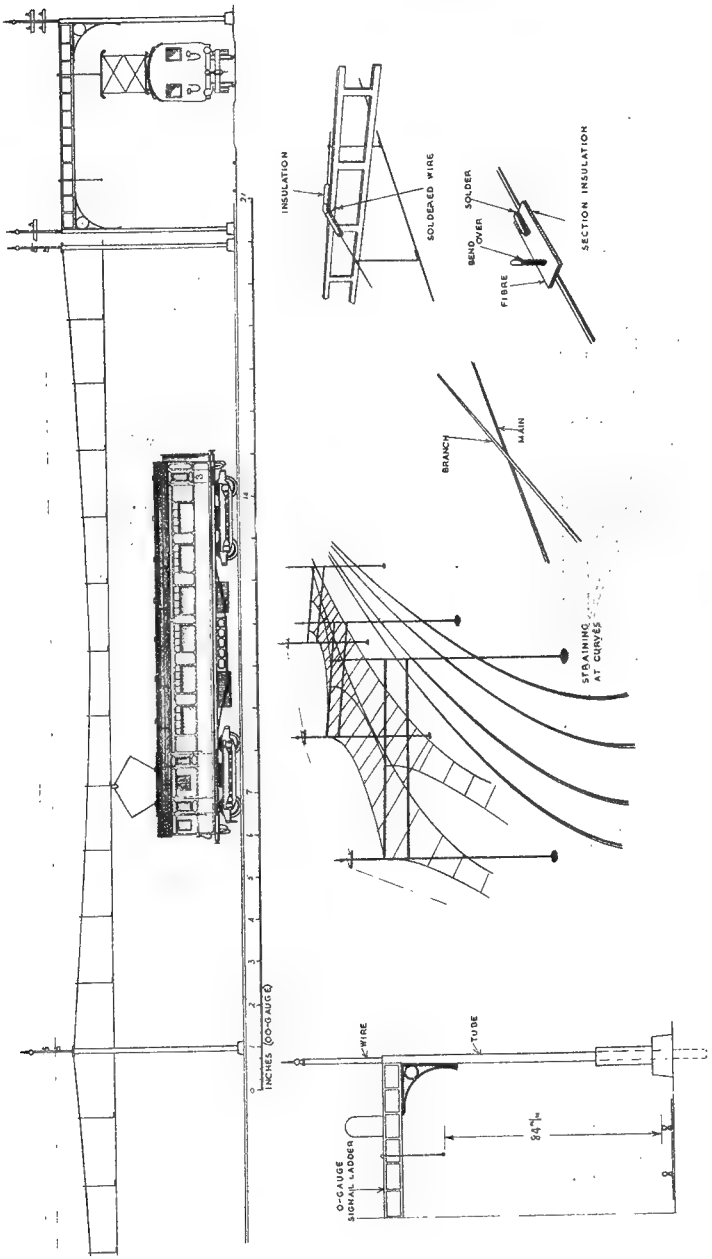
The double through road is a formation which may often occur on the main line of a fair-sized layout where there are quadruple tracks, and may form part of a continuous run, for both directions of traffic. Here, the two middle roads have isolated sections for the automatic stoppage of fast traffic, and should this be desired it will be necessary to instal point-operated section switches as before. Our purpose here, however, is merely to indicate the method of wiring the various conductors.

Here, again, there is a need to provide against the possibility of passing-contact, where the collectors of trains may foul the ends of opposed sections of conductor rail. I have therefore given a diagram suggesting several methods of arranging conductors so as to render this impossible.

There are various methods of wiring outside conductors, depending upon the position which the conductors occupy in relation to their respective running rails; but the principle is always the same. It consists always in simply *wiring broken sectors of the conductor to the conductor along the main tracks to which they pertain*, and in taking care to guard against any possibility of short-circuiting by passing contact. It is well also to be on one's guard against the duplication of wiring.

The third rail was formerly placed inside the running rails, and not on the outer side as is now almost universal practice. There is really little doubt about the vast superiority of the outside conductor over the inside type; and for that reason it is not thought necessary to multiply instructions by dealing with the latter.


A
B
USE OF YARD PLUGS OFF MAIN CONTROLLER OR SEPARATE CONTROLLER
A
B
L
R
F
INTERLOCKING POINTS WITH CURRENT
AVOIDING CONTACT BY
RELATED LINKS AND SHORTENED ENDS
AVOIDING PASSING-CONTACT BY
ADJACENTLY RELATED LINKS



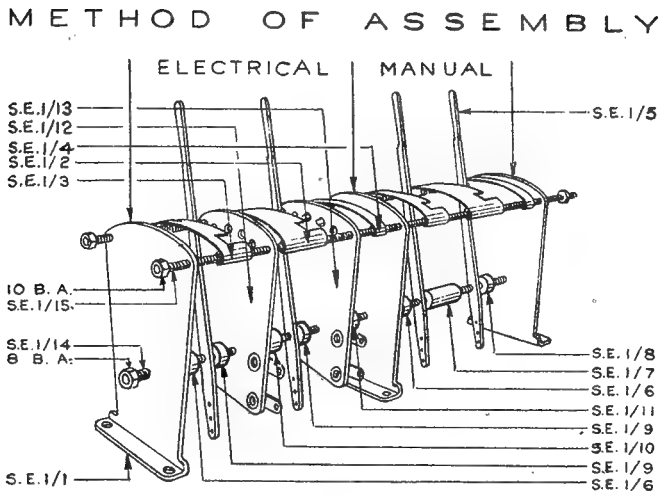
OVERHEAD CATENARY SYSTEM

There is, however, still a real demand for overhead cable conductors, both from the standpoint of interest and realism where types of electric power are in service which involve such an arrangement. Electric tramways, suburban electric multiple-unit trains, and other systems of motive power involve the overhead method. Drawings are therefore given which should serve to make clear some details of this work. The suburban electric railway makes a most attractive addition to an existing layout. It is a side-line which can often be added with only a single track, and will fit into a very narrow right-of-way. On such a subsidiary, stiffer grades are possible, for trains need not be lengthy and may even consist of one car only. Cars can take much shorter curves and few facilities are demanded. The drawings indicate the suitable distance to allow between the standards, a description of the standards themselves, the spacing and placing of the hangers from the messenger to the contact wire. The best messenger wire to use is braided radio aerial wire, and picture-hanging wire is also good. For the contact wire (0-Gauge) use No. 16 or 18 copper wire. On sharp curves, the catenary should be furnished with pull-offs, and these are shown in the sketches. The messenger wire must be insulated from the lattice supports, and the lattice itself serves well to give the positions from which to strain the wire. The number of upright supports for the contact wire should be counted before attaching the messenger and the correct number of insulating fibres slipped on. The method of crossing the contact wires is also shown, and also the way to form insulated sections. The latter work is done by using a small block of fibre with drilled holes, through which the contact cable is slotted and soldered. At points, the point contact wire is passed over the main, and the hangers must be so arranged that when the collector lifts the wire under which it is running, the other contact wire will lift simultaneously.

CONTROL

POINT OPERATION IN THE SMALLER SCALES

Something requires to be said in a treatise on power supply upon the subject of point operation, for in a measure this affects the main theme. The standard method of point operation by means of rods and cranks, as applied usually to 0-Gauge, actually belongs, and shall be dealt with, under the head of engineering; but with the lighter materials employed in the smaller standards the writer does not advocate this method as suitable. For 00-Gauge—and it may well be for 0-Gauge, since the Americans have largely adopted it—there is nothing to beat the tubular system long advocated by the author and devised by him. The system has been greatly improved and perfected with the movement of time and experience, and it may be found very often to combine admirably with the use of electric point-machines, though this is not recommended over wide areas or with any degree of pull-load. The system is that of using light steel piano wire slotted through $\frac{1}{16}$-in. copper tubing which can in normal times be bought in long straight lengths. The scheme can be worked with the utmost efficiency along with standard lever frames like the Zenith type. The tubing can be laid either below the baseboard or on its surface, and in the latter instance is no more unsightly than point-rodding. Materials required consist of tubing, wire, and numerous standard brass plates about $\frac{3}{8}$ in. by $\frac{3}{4}$ in., drilled with two holes each for small wood screws. The wire must always be well greased before being slotted through the tubing. The method is shown, first, as applied to a simple turnout. It will be seen that the wire will readily take a fair curve of the tubing, which must be curved with the wire inside. No cranks whatever are needed, and no curve of a sharper radius than $1\frac{1}{2}$ ins. should be made. If the tubing is on the surface it is arranged as shown with the simple turnout. The plate nearest the point is sweated underneath the tubing, first having been screwed in place, and the tubing having been duly shaped. A second plate is attached just behind it above the tubing, the tubing being pressed firmly down into the soft texture of the Tentest or pulpwood of the baseboard. If a harder wood is used, the tubing is better on the underside of the base. All other plates are attached on top of the tubing, and numerous lengths of tube to various points can be grouped as shown. The attaching of the wire to the point-rod strip is very simple, care only being needed to get a good



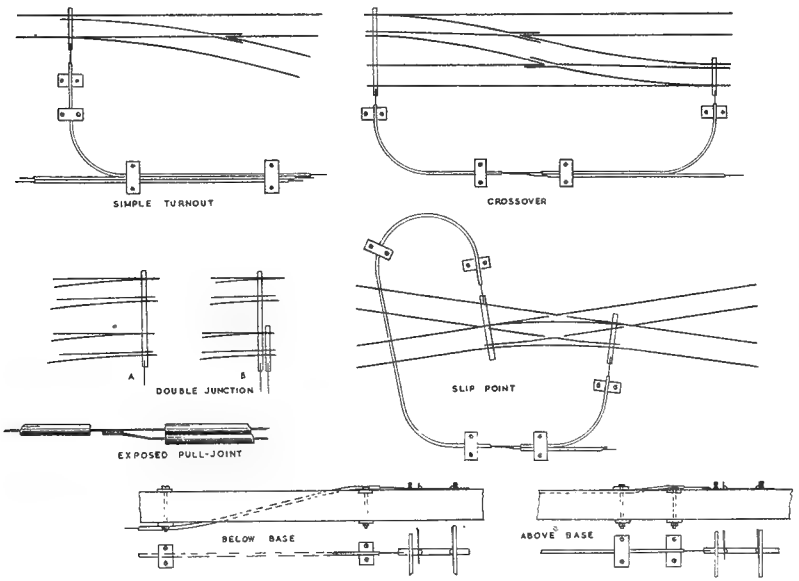
COMPONENTS :

S.E.1/1. Frame Ends
S.E.1/2. Quadrant Sections : Large
S.E.1/3. ,, ,, Small
S.E.1/4. ,, ,, Spacing
S.E.1/5. Levers
S.E.1/6. Spacing Pieces
S.E.1/7. ,, ,,
S.E.1/8. ,, ,,
S.E.1/9. ,, ,,
S.E.1/10. ,, ,,
S.E.1/11. ,, ,,
S.E.1/12. Contact Plates (Permanent Contact)
S.E.1/13. Contact Plates (Passing Contact)
S.E.1/14. 8 B.A. Fulcrum Rod
8 B.A. Nuts
S.E.1/15. 10 B.A. Quadrant Rod
10 B.A. Nuts

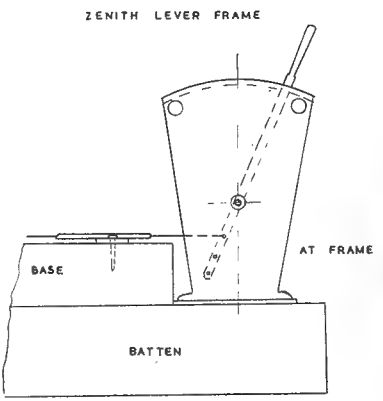
METHOD OF ASSEMBLY OF ZENITH LEVER FRAME

welded joint and enough clearance to allow the point to work over. Nothing indeed could be simpler than this method of negotiating a most difficult track problem, and I have always been astonished that every small-gauge enthusiast has not adopted it. I have fitted literally hundreds of points of all kinds to operate in this way, with never a trouble, and the mechanisms stand up to years of constant service.

Sectional diagrams and plans are also shown as applying to surface and sub-surface work at the points themselves, and a diagram indicates the requisite arrangements at a lever frame. The diagonal holes in the pulp-wood can be bored in an instant with a brad. Beware of kinks in bending,



TUBULAR POINT OPERATION



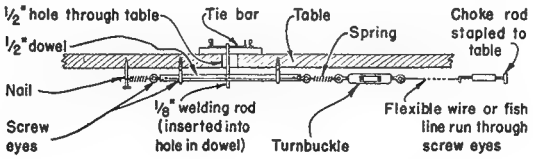
and always bend the tubing with the greased wire inside it. In cutting the tubing the wire may be absent, but the immediate end of the cut will require slight filing.

Crossovers can be worked at both points simultaneously as shown, and here there is a call for an exposed pull-joint. An enlarged sketch is given. Double junctions may be operated with separate or simultaneous points, as at A and B. Slip points are as easy as any others.

For 0-Gauge, the Americans frequently use a larger calibre of tubing with a stouter wire, and they carry the tubing great distances to the main switchboard, where the operating mechanism consists of a motor-car choke-knob, which can be set locked by a twist of the hand. A sketch by Mr. James Dechert illustrates the scheme.

In the instance of plain turnouts at goods yards and similar locations the simple point-lever is still a prime favourite. Such levers are obtainable commercially in all the scales. They lend themselves also to use along with the tubular method of operation already described. One lever will readily operate the two entrances to a crossover simultaneously. The lever frame is only recommended when it is desired to gather up all the point controls into one central place, or to fit these within the walls of a signal cabin or control box.

We dealt under the heading of switches for the trackside with the deservedly popular point-machine, and it is necessary at this juncture to make some remarks as to its installation and location. The mounting of these machines is carried out as a general practice on the upper surface of the baseboard, and there is nothing objectionable in this procedure, provided that some method may be found of covering the mechanism when installed. But certainly the most tidy method is that of mounting the appliance underneath, so that from the upper side it will be totally invisible. It also happens that much depends not only upon when the machine is placed but upon how it is situated in relation to the point it has to operate. If it is placed below the baseboard it lends itself to a scheme of linking-up to the point-rod which is extremely effective in its working. In the smaller scales it will usually be found that the extent of the " throw " of the machine does not correspond to that amount of throw required for the point, so that some form of springing is indicated as essential which will permit a measure of compensation or variation between the two, and which will also, fortunately enough, serve to introduce the function of a spring to grip the point-blades in place when the point is set either way. Such a spring-grip is most desirable with three-rail supply, and is absolutely necessary with two-rail when the point-blades are depended upon to form electric contact. Further, the form of springing adopted must be definite but yet fragile, so that the machine will not feel the stress too much on the coils. This is easily secured by placing the machine as suggested in the sketch. Here it is viewed, as it were, through the transparent top of the baseboard ; A being the machine, B a short length of tubing, C a rectangular piece of piano wire to form the compensating spring. It will thus be obvious that when the machine is thrown the variation in throw-length becomes an advantage, the greater amount of " push " being at the machine end of the rod.



THE DECHERT POINT SYSTEM

CONTROL

SECTIONALISING THE TRACKS

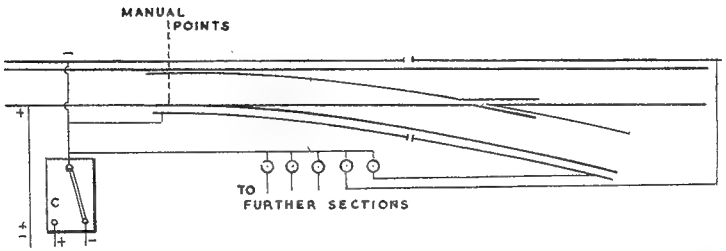
By the sectionalising of current is implied the dividing up of the track into short sections—sidings, locomotive stances at various places, engine stalls at sheds, certain blocks on the main line—in order that these may be separately controlled. If you intend to run more than one engine at one time anywhere on the system the need of sectionalising immediately arises. Even if you wish to operate separate trains on the up and down main roads you will require to divide the power control into two sections. But you will undoubtedly desire more than that. Actually, it is not often that the need arises for one operator to run more than one train on the main lines at once. In practice it will speedily be found that one train is itself enough to occupy the attention of the worker. But it is a great convenience and necessity to be able to attend to the movements of trains in yards while some main-line train is negotiating the long journey before it. This, however many divisions of the tracks are required for these purposes, will, at least, be essential. Some of these sections will need to be under the same controller, while others will have separate speed and reverse controllers of their own. A usual procedure, assuming no other urgent occasions for division arise, is to have an up- and down-line controller (two units) and a controller for each yard. There will also in all likelihood be plugs switches operating sidings and stances at various places for locomotives.

It should be borne in mind that even the main line will probably require to be divided in some measure. The speeds of trains moving in the same direction may vary according to timetable. One train may be scheduled to arrive at a given destination ahead of another train after which it departed. There will be slow and fast traffic, stopping trains and expresses. So, it will be necessary to provide passing loops or overtaking loops along the way. These must be capable of being switched in or out at will, while the main line remains under power.

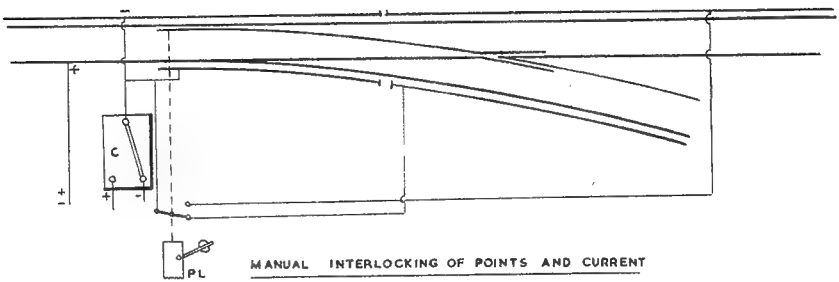
Before any decisions as to sectionalising are arrived at, therefore, the operator should give time and thought to a careful study of the layout plan, endeavouring to imagine all possible train movements, whether on the mains, at yards or in stations. Not only must the main movements be visualised, but also all the minor operations involving servicing of engines,

shunting, goods arrival and departure, movements at industrial sites, and so forth. There are also further occasions for the forming of sections where opening bridges occur, and the arrival and departure platforms at stations call for attention especially. The connections for current to the tracks at an opening bridge are shown in a diagram on page 12, as well as the method of making the switch-contact to bring the bridge tracks into circuit when the deck is down. There are various other methods of forming these power contacts which will be described at a later stage in this series. The matter of platform tracks and their sectionalising is a further item for consideration. The first question to settle is whether the main arrival and departure platform tracks of a station are to be in circuit with the up-and down-mains, or whether they are to be in one circuit with the yard. The latter scheme will mean that before trains arrive the yard controller will have to be flipped over in tune with the main controller, and this, of course, defeats for that moment the function of the yard controller as such. The better scheme is the former. The short section of rail at the inner end of the platform arrival road may be wired with a push-button switch as shown on page 12, and the same, naturally, applies to the outer end of the departure track.

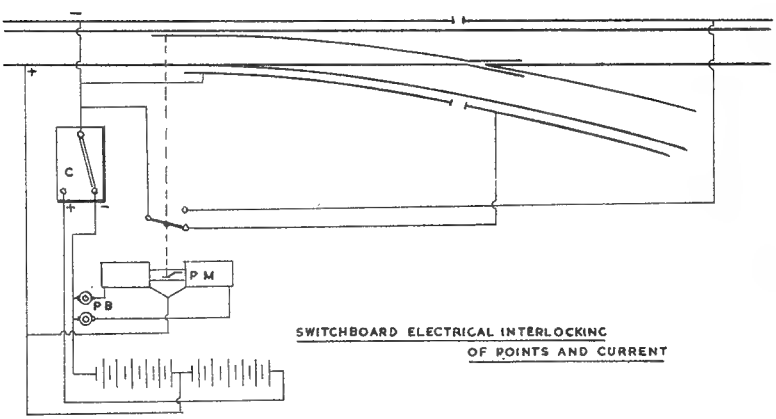
We come, then, to the work of sectionalising itself. Of many possible ways of doing this, we name at the present stage four, and they are drawn out for the reader's guidance. They are as follows : (1) supply of power to sections from the switchboard, the points being worked manually ; (2) the point-lever (manual) itself being arranged to operate a local switch ; (3) operation of both point and current supply in one movement from switchboard ; (4) the interlocking of signals, points and track-power in one switchboard movement. With the fourth method we shall not deal at the moment, but will postpone the discussion of it until we are dealing with electric signals. Starting with the first method, then, it must be assumed that the point is operated by some mechanical contrivance itself on the switchboard alongside the track-power tumbler switch. In the diagram, there are several other section-tumblers included. This method is very simple. The second method is perhaps the best of all for locally-operated manual points ; a point-lever is shown linked up to a section switch of a primitive sort, and a larger diagram is also given to show the general idea of this interlocking of the track-power with the point movement. In all these four methods we assume the split-potential system of supply. Passing on to the third diagram, we have a switch machine, as already described, having two coils, each operated by a press-button (PB), and the movement of the points by the machine throws over the track-power



SWITCHBOARD CONTROL OF CURRENT ONLY

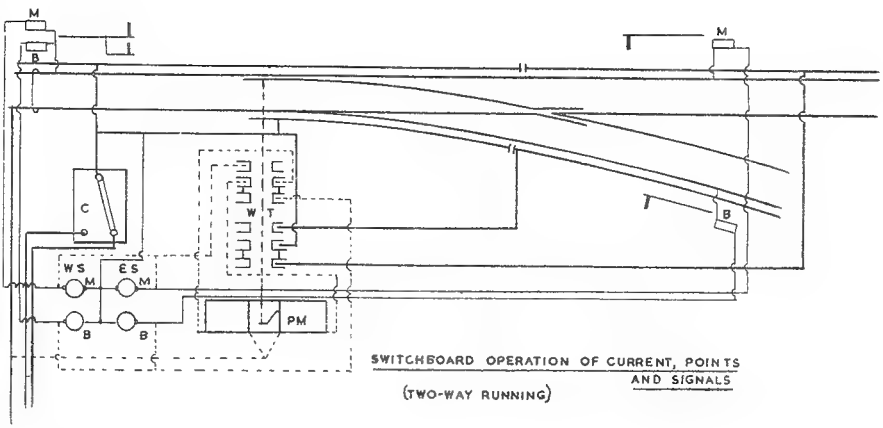


MANUAL INTERLOCKING OF POINTS AND CURRENT



SWITCHBOARD ELECTRICAL INTERLOCKING
OF POINTS AND CURRENT

FOUR METHODS OF SECTIONAL CONTROL
(Above and at top of facing page)



SWITCHBOARD OPERATION OF CURRENT, POINTS AND SIGNALS
(TWO-WAY RUNNING)

into the open track. We are therefore controlling, by means of the press-buttons and the controller, the direction of train movement (forward or reverse), the setting of the point, the " on " or " off " of the track-power, and the selecting of one or other of the involved tracks for energy. Whether the method of (2) or (3) will be used depends mainly upon the distance of the siding from the switchboard, and upon whether the siding is located on the main line or in a locally-operated yard. If the siding were, for instance, a main-line loop, then the method of (3) would be followed. Method 4 would be the same scheme for the same location provided with signals.

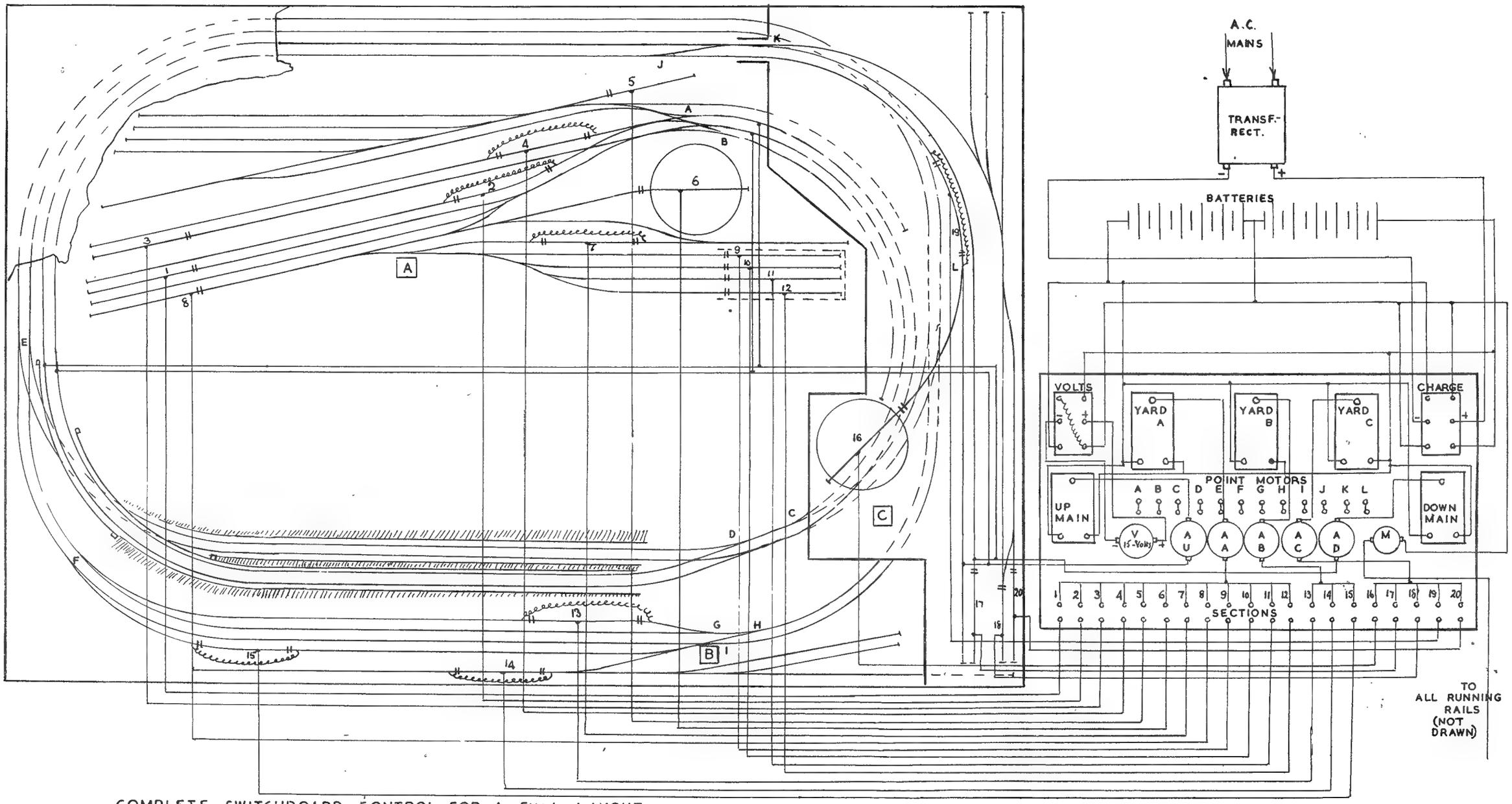
So much for the elementary facts concerning sectionalising. If we now depart from the subject for a time, it will only be to turn to it repeatedly in the course of our study. Sectionalising is linked up with all forms of power control, and once the main idea is mentally digested, it is readily understood whenever the need emerges.

CONTROL

CONTROLLING A FULL LAYOUT

It will be remembered that in the elementary scheme for a switchboard we gave details for the arrangement of switches and for the wiring on the back of the board. It is proposed to confine ourselves strictly to the precise method of wiring there described, but at this point to extend the instructions to cover the wiring and control of a full layout of modest proportions. A complete diagram of the layout, switchboard and wiring is given. Probably the beginner will feel somewhat perplexed as he inspects it; but he can be assured that there is really nothing whatever complicated about it all, apart from its apparent multiplicity of wires and connections. It is actually exceedingly simple. All the wires from board to layout do exactly the same work in every instance.

Consulting the switchboard itself, we have five main controllers, up-main, down-main, and three for the separate yards, there being three stations. There is the charging switch and the voltmeter switch, a voltmeter, an ammeter for each controller section (up, down, and A, B, C), a dozen push-buttons for various point-machines (the wiring for these not being drawn); and there is also a master switch (M) and 20 small section-plugs or tumblers. It is assumed that the whole of the running rails are bonded as one element, and the leads to the running rails are therefore not indicated. All the wires from the switchboard go to sections of the outside conductor rail, supplying one element only of the circuit, the return being through the running rails. The main-line controllers feed into the main lines at three places. Section switches apply to given locations where it is necessary to cut out or set in locomotives. These sections on the layout are numbered in harmony with the numbers on the switchboard. If preferred, small printed labels describing the name of each siding may be substituted on the switchboard for the numbers. The best way for the beginner to discover the simplicity of the diagram is for him to start off from one of the ammeters (say A-U, which is the ammeter



COMPLETE SWITCHBOARD CONTROL FOR A FULL LAYOUT

EXCLUSIVE OF SIGNALS — POINT MOTOR CONNECTIONS NOT SHOWN

for the up-controller) and to follow the lead out to the main up-lines which it serves. Then let him take one of the yard ammeters (say A-B, which has only three sections and serves Station B), and the rest will be quite plain. Jumping connections, where they are required as links to by-pass sections, are indicated as flexes.

Having followed out the various sections and main-line leads, the student may then work back from the ammeters to the various controllers and other appliances, and right back to the batteries and power-unit or charger.

This scheme of wiring is offered as the best and simplest possible. If preferred, of course, the yard controllers may be taken off elsewhere, to locations nearer to their yards, and so on. Nor does this control diagram exclude other additional controlling devices such as a diagrammatic board to indicate the position of trains by the use of pilot lamps, or to divide up the tracks into sections for detection of faults. Such a diagrammatic board (to be later described) might well be set up immediately above this switch-board. It will be noticed that no fuse or cut-out is included. If this adjunct is desired it might be inserted in the lead from the master switch to the running rails. I myself have operated a layout without any calamity to batteries or mechanism for over 20 years without any such appliance.

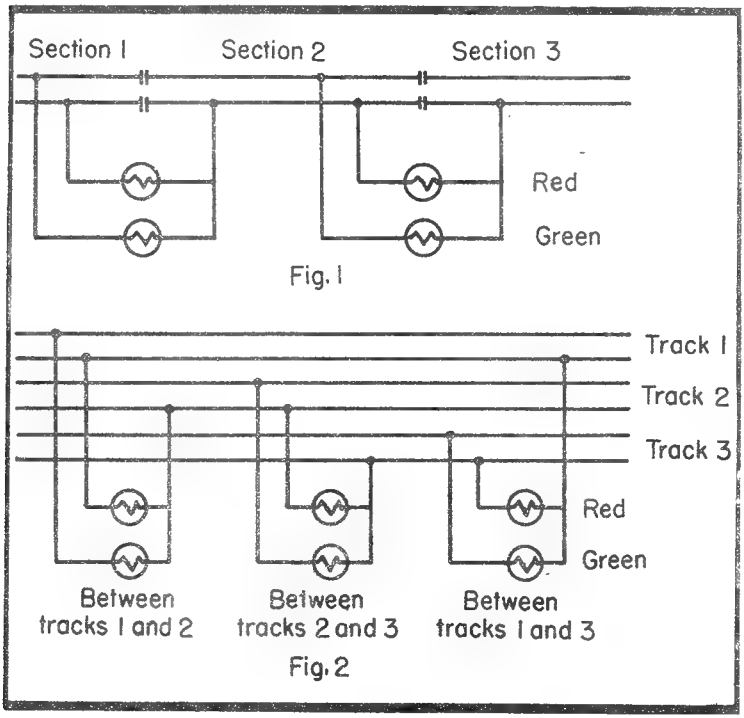
Let us proceed to follow out one or two traffic movements. Thus, at Station A, the section 1 is a dead-end of an arrival track; the arrived engine can be plugged out while another engine is run on to the end of the train to take it away and to open up an exit for the arrived engine. Section 2 is a track for holding up or starting off trains from the departure platform, and can later be provided with starting signals to work in advance circuit with the engine-power supply. That is to say, a starting signal can be wired into the section circuit in such a way as to go to "off" about 30 seconds before the power-to-engine relay comes into operation. The ludicrous starting of engines instantly the signal falls is thus avoided. At Station C, the sections 13 and 15 enable slow trains to be held in waiting while fast trains run by.

The one defect of thus having all the yard controllers on the same board as the main controllers is that there may be tracks in the actual yards which have lever-operated points, and it will be thus necessary to walk over to the yard to operate these, or to have a second operator in service. The solution is to have either all points electrically-operated or to have yard controllers located at yards, the ideal method being the former.

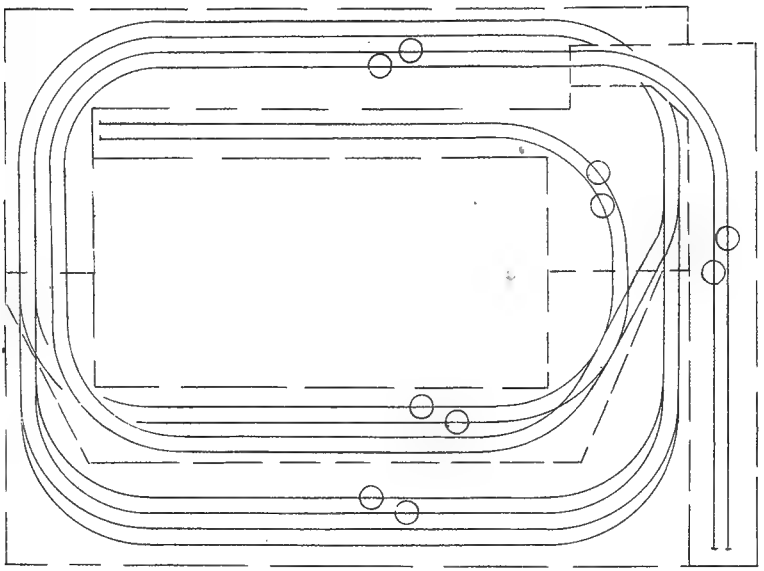
CONTROL

SOME USEFUL ELECTRICAL EXPEDIENTS

Polarity Lights. A very simple light-indicator device is illustrated whereby the polarity of adjacent tracks may be shown on a switchboard where two large sections of a layout adjoin each other, one perhaps being in another room. By this arrangement of wiring and lamps, the red light will show when the tracks are not harmoniously poled, and the green lamp when the poling is correct. In the second drawing three tracks are shown, as they might occur with crossovers linking them up. Here it is necessary for polarities to be in harmony between tracks 1 and 2, or 2 and 3, or 1 and 3. Should one of these sections be reversed, the lamps will change to red; should they be in tune the light will be green.



POLARITY LIGHTS

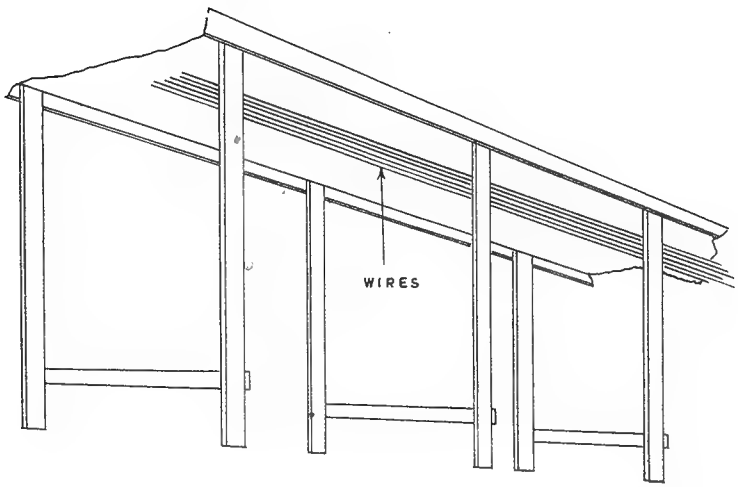


DIAGRAMMATIC SECTION BOARD

Diagrammatic Section Board. We have referred to the desirability of a board displaying a diagram of the tracks for a layout, and in this drawing such a diagram is given for the layout already described. The routes (main only) are shown by a single line, red for the up and blue for the down. The 10 switches shown by circles are for the purpose of cutting in or out the current for the up- or down-roads within the dotted area and these areas may include the yards and stations which they embrace. It is thus the work of one minute to discover the location of a fault in distribution, whether a break or a short, by switching out the sections one after another. If so desired, pilot lights may be placed also for each section, arranged with track circuits to indicate the presence of trains.

The diagram board may be of plywood to any desired dimensions, painted dead black, the tracks being lined out with red and blue paint, the whole being then varnished when dry. Like a switchboard, it should be arranged to swing forward and downward on a pair of small hinges for convenience of access to the back.

Arranging and Labelling of Wires. A sketch will serve to indicate the best way of arranging the multitudinous wires beneath a baseboard, by stapling them on the rear side of the front supports. This work should be done neatly and with due regard to the destination of the leads, the wires

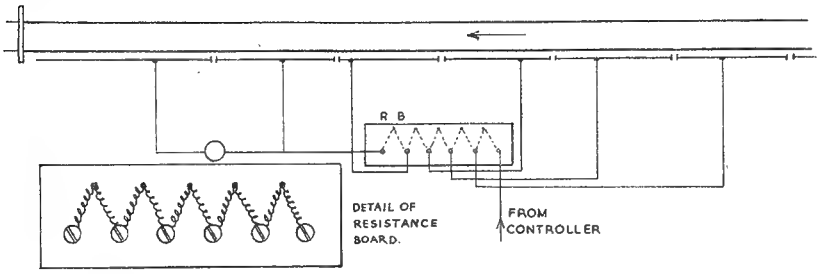


ARRANGING AND LABELLING WIRES UNDER BASEBOARD

themselves being subsequently labelled clearly to indicate their purpose. If it is possible in these times to adhere to a strict system of coloration for the cables, so much the better.

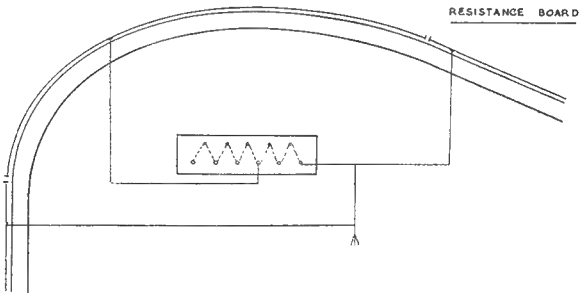
Track Wiring Drawings. I would strongly recommend every owner of a layout operated electrically, no matter what may be the pretensions of it, to keep on file a detailed drawing of the wiring scheme from mains to sections. It would amaze the tyro to know how often I myself have completely forgotten the wiring system of the West Midland Lines until recourse was had to this expedient. This, no doubt, speaks as well for the workability of my system as it speaks badly for my memory; for it often happens that the intervals which occur during which no thoughts of the scheme are required are most extensive. The amateur, therefore, should avoid the annoyance of having to get below the tracks to make wiring investigations which would be unnecessary if a key drawing were immediately available.

Automatic Slow-Down for Arrival Track. It is a very excellent thing to instal some form of automatic speed reduction in order to secure that trains arriving in stations shall, both for purposes of realism and safety, make a gradual halt rather than a sudden one. A simple method is to make a small resistance board as shown in the drawing—an appliance much like that of the resistances on the controller. This consists merely of six hexagonal bolts, a few pieces of resistance wire and five large-headed sprigs.



AUTOMATIC SLOW DOWN FOR ARRIVAL TRACK

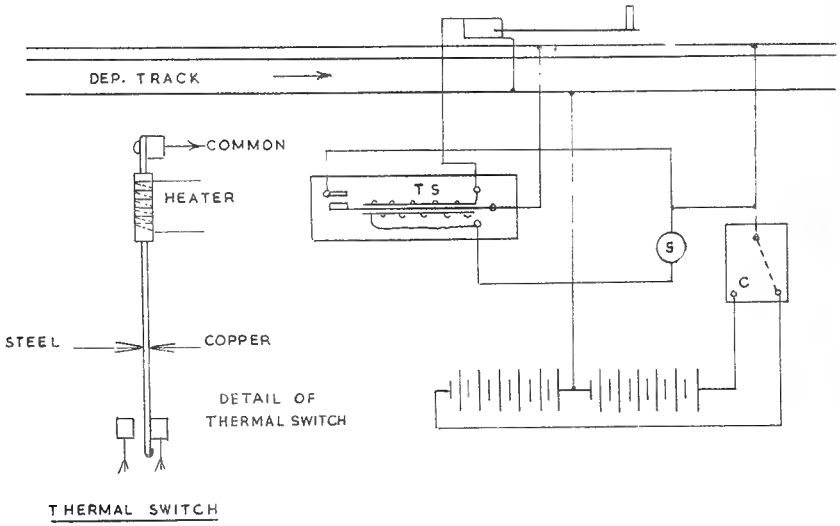
The feed from the controller to the whole of the arrival track is passed through this resistance in stages, as shown, the conductor rail being divided in six places to take it. The dead-end section with the press-button control should be at the same resistance as the penultimate section. It will thus be found that trains arriving under the guidance of the main controller, will themselves reduce speed and come to a very gradual halt. The exact amount of resistance wire to be used can be ascertained quite easily by trial.



SLOW DOWN FOR CURVE

Speed Reduction on Curves. The same arrangement can be applied to curves along the main line, since it is at these places that derailments most often take place. In this instance the reduction may be in one phase only—say from the centre of the resistance block, or from whatever terminal is the most suitable—and the arrangement itself will be a security against a lapse of memory on the part of the operator.

It will be obvious enough that this arrangement can be applied at various places on a layout—notably at those points where signals cut out the power from a certain section and are required to halt a train which



THERMAL DELAY SWITCH FOR STARTING SIGNAL

would otherwise run against controls. Instead of actually cutting out the circuit for such a train, the operation of the prohibiting signal would change over the train's circuit and pass it through a resistance block.

Turntable Sectionalising. It is possible to arrange that the movement of the deck of a turntable itself serves to energise the track opposite which the turntable is stopped. The principle is much the same as common sectionalising. In the writer's opinion there is actually little demand for this arrangement, since the current on the deck may be controlled by a tumbler switch and the off-going tracks can be kept in constant circuit. A much more important matter is that of arranging a definite lock for the turntable deck in dead line with the track to be served.

SIGNALLING

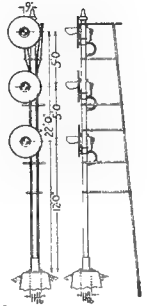
MINIATURE SIGNALLING SCHEMES IN GENERAL

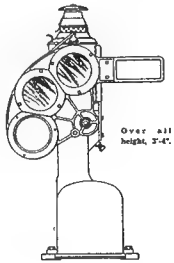
IN ACTUAL practice, signalling may be carried out by means of either semaphores or lights, the former either lower- or upper-quadrant, the latter either two-indication or three-indication. In America and elsewhere there are further modifications under the latter category. Searchlight signals are colour-lights of a very powerful nature whose rays are clearly discernible during daylight at a great distance. In a series of drawings there are given instances of most of the types which affect our study.

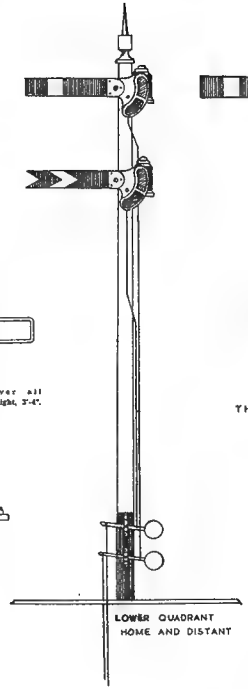
Originally, all signalling was carried out manually, and this is still the method in vogue over the greater proportion of the world's railways. The advent of the track circuiting system brought in the first modification of the manual block scheme. Here, in place of levers and cranks, with lengthy wires along the trackside, the trains themselves operate the signals by means of relays. The two poles of a battery are attached to the running rails and retain the signal at " clear " unless there is a train in the section. When there is, the wheels and axles of the train short-circuit the current of the battery so that the signal goes to " stop." It was probably this improvement that first gave model engineers the notion of utilising the track rails for the entire operation of a miniature signalling system.

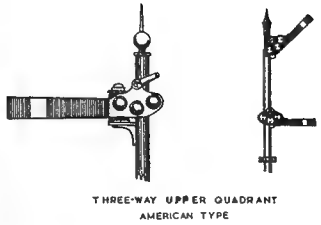
A further hint came to model engineers from actual practice when power signalling was introduced and signals were operated by a heavy-duty machine which could be energised by merely pressing a button. In the modelling realm, this innovation heralded vast possibilities.

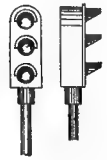
We therefore have a choice before us in deciding how our miniature scheme shall be carried out. It may be by means of track circuits, or by switchboard controls, or by manual levers on the trackside, or, indeed, by means of a combination of all these systems. One basic principle upon which the builder must decide at the outset is whether the signals shall control the trains or the trains control the signals—that is, whether the work shall be done by track circuits or from the switchboard. It will

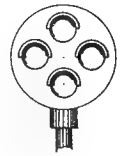


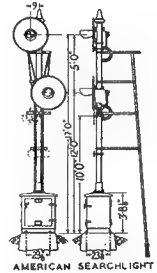


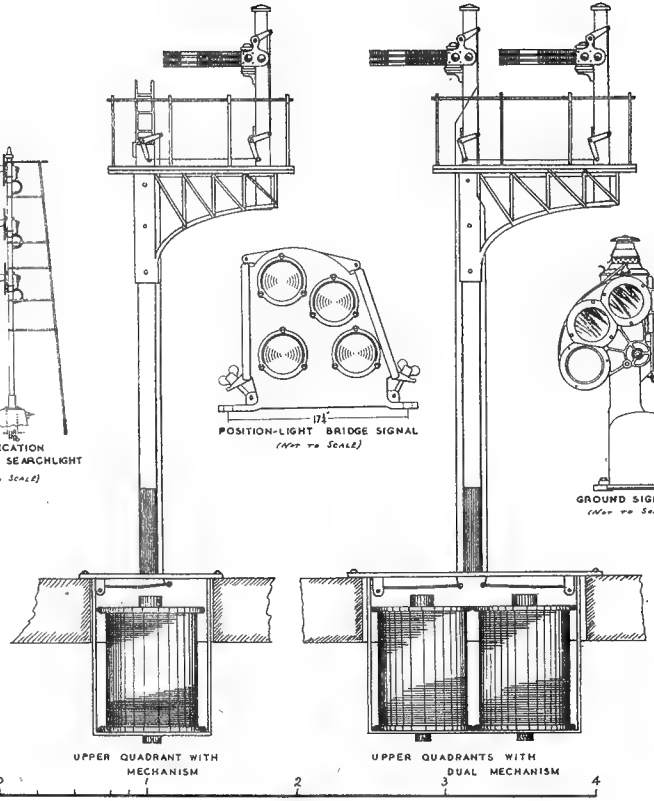












SIGNAL TYPES

SIGNAL TYPES

also be found that the work of signalling verges upon that of sectionalising, and even also that of point operation. A method may be adopted of working signals which are interlocked with points, where the points also cut in or cut out the motive power current on certain tracks. All this is excellent, in that it reduces the series of operations necessary for a given movement.

But even when it has been decided whether the method shall be from the tracks or the switchboard, it will still be needful to have a form of local manual operation at yards. For here there will be numerous sidings without signals or with signals of the dwarf type.

One principle may be laid down definitely for all forms of operation —the signal itself in the smaller gauges should be an electric one, whether semaphore or colour-light. Crank-operated types are out of date for the lesser scales. The magnet type is so much more reliable and much less complicated. We may now therefore tabulate the system to be selected as coming under one of the following heads :—

(1) *Yard.* Dwarf signals or sections worked from local ground levers alongside the points.

(2) *Main Line.*

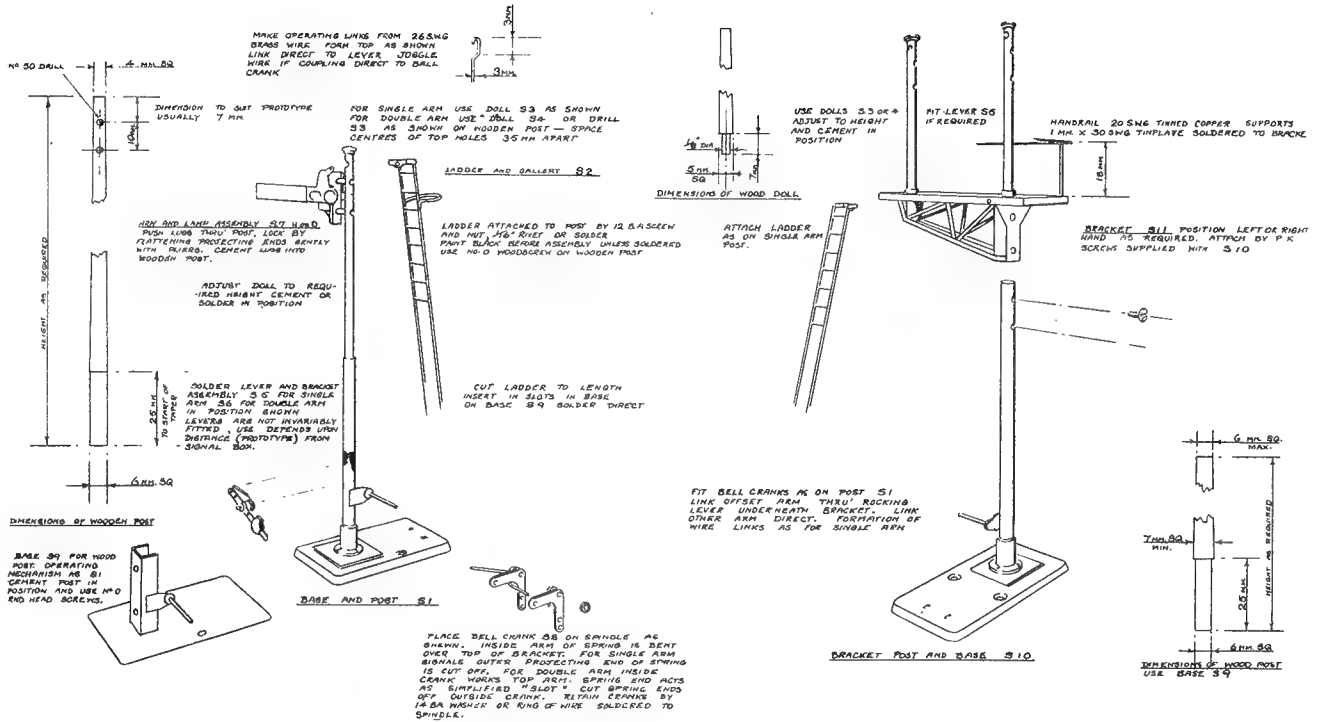
Either (*a*) worked from switchboard, or

(*b*) worked by track circuits.

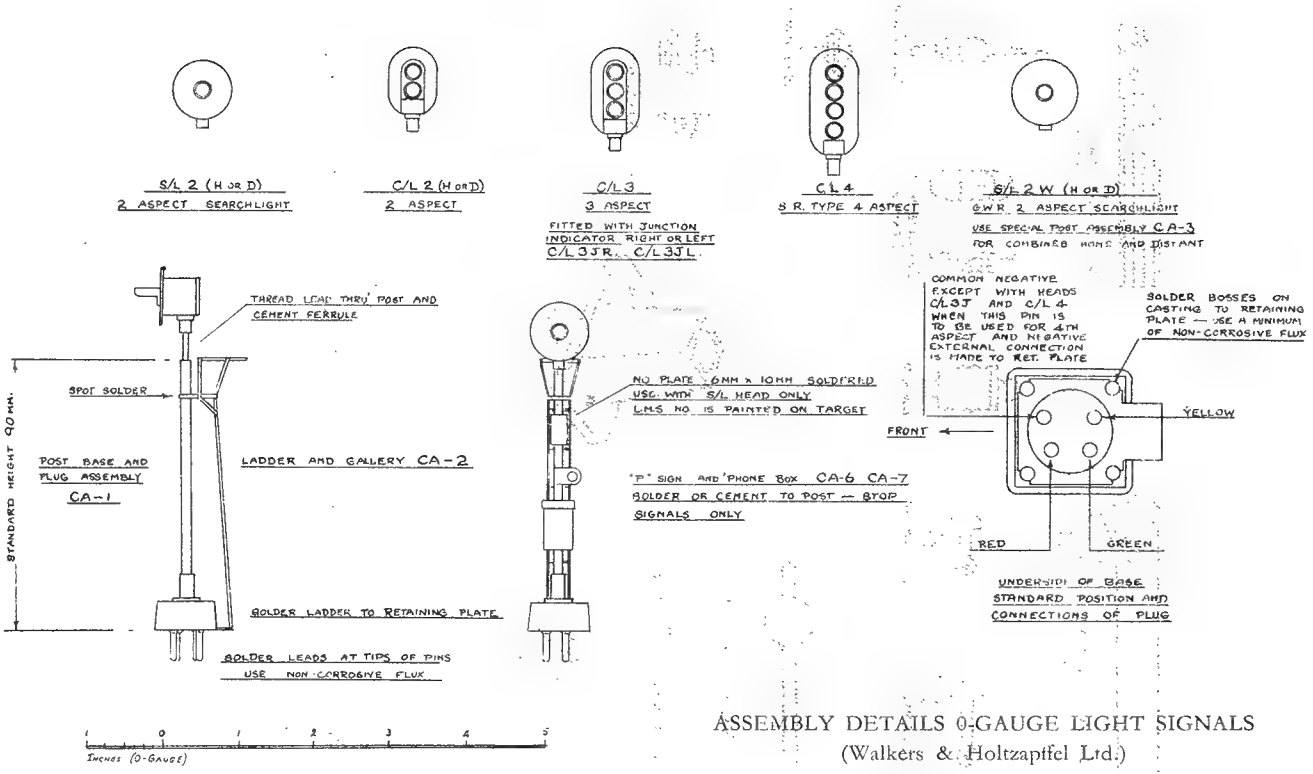
All of these may be separately switched (signals, points, sections), or all interlocked, so as to work by one switch movement.

" Main Line " here also includes station platform signals and tracks.

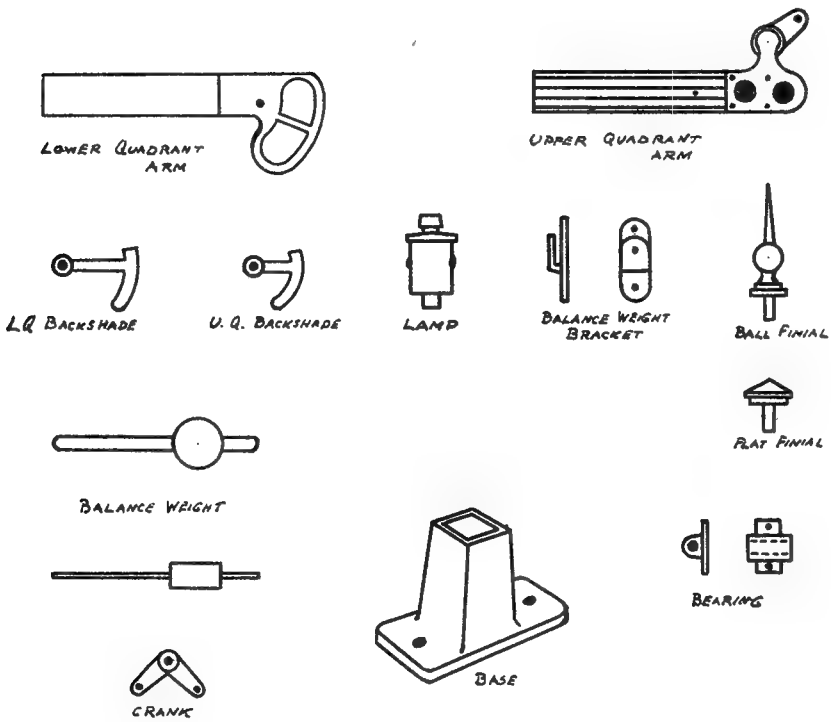
Let us first look at the possibilities of switchboard control. Here, the actual signals may be upper- or lower-quadrant semaphores, or two-indication colour-lights. For any of these the system of wiring will be largely the same. Semaphores will be operated by a magnetic arrangement at the foot of the posts ; lights will be operated either by the same magnetic process moving a vane at the base of the post, or by the use of two separate lamp circuits in the same position. All these methods will be described in their turn. In the instance of track circuiting, again, three-indication semaphore arms will be used, or, alternatively, three-indication colour-lights —introducing the " stop, caution, go " principle.


MAKE OPERATING LINKS FROM 26 S.W.G BRASS WIRE. FORM TOP AS SHOWN LINK DIRECT TO LEVER. JOGGLE WIRE IF COUPLING DIRECT TO BALL CRANK
3mm
3mm
No 50 DRILL
4 mm SQ
DIMENSION TO SUIT PROTOTYPE USUALLY 7 mm
FOR SINGLE ARM USE DOLL 93 AS SHOWN FOR DOUBLE ARM USE DOLL 94 OR DRILL 93 AS SHOWN ON WOODEN POST — SPACE CENTRES OF TOP HOLES 35 mm APART
USE DOLLS 53 OR 4 ADJUST TO HEIGHT AND CEMENT IN POSITION
FIT LEVER S6 IF REQUIRED
HANDRAIL 20 S.W.G TINNED COPPER SUPPORTS 1 mm. x 30 S.W.G TINPLATE SOLDERED TO BRACKE
18 mm
4 DIA
5 mm SQ
7mm
DIMENSIONS OF WOOD DOLL
LADDER AND GALLERY S2
ARM AND LAMP ASSEMBLY S7 USED PUSH LUGS THRU' POST, LOCK BY FLATTENING PROJECTING ENDS GENTLY WITH PLIERS. CEMENT LUGS INTO WOODEN POST.
LADDER ATTACHED TO POST BY 12 B.A SCREW AND NUT, 1/8" RIVET OR SOLDER. PAINT BLACK BEFORE ASSEMBLY UNLESS SOLDERED USE No. 0 WOODSCREW ON WOODEN POST
ATTACH LADDER AS ON SINGLE ARM POST.
BRACKET S11 POSITION LEFT OR RIGHT HAND AS REQUIRED. ATTACH BY P K SCREWS SUPPLIED WITH S10
ADJUST DOLL TO REQUIRED HEIGHT CEMENT OR SOLDER IN POSITION
HEIGHT AS REQUIRED
SOLDER LEVER AND BRACKET ASSEMBLY S5 FOR SINGLE ARM S6 FOR DOUBLE ARM IN POSITION SHOWN LEVERS ARE NOT INVARIABLY FITTED, USE DEPENDS UPON DISTANCE (PROTOTYPE) FROM SIGNAL BOX.
25 mm TO SUIT PROTOTYPE
CUT LADDER TO LENGTH INSERT IN SLOTS IN BASE ON BASE S9 SOLDER DIRECT
6mm SQ
DIMENSIONS OF WOODEN POST
FIT BELL CRANKS AS ON POST S1 LINK OFFSET ARM THRU' ROCKING LEVER UNDERNEATH BRACKET. LINK OTHER ARM DIRECT. FORMATION OF WIRE LINKS AS FOR SINGLE ARM
6 mm SQ MAX.
7mm SQ MIN.
HEIGHT AS REQUIRED
25 mm
6mm SQ
DIMENSIONS OF WOOD POST USE BASE S9
BASE S9 FOR WOOD POST OPERATING MECHANISM AS S1 CEMENT POST IN POSITION AND USE No 0 RND HEAD SCREWS.
BASE AND POST S1
PLACE BELL CRANK S8 ON SPINDLE AS SHOWN. INSIDE ARM OF SPRING IS BENT OVER TOP OF BRACKET. FOR SINGLE ARM SIGNALS OUTER PROJECTING END OF SPRING IS CUT OFF. FOR DOUBLE ARM INSIDE CRANK WORKS TOP ARM. SPRING END ACTS AS SIMPLIFIED "SLOT" CUT SPRING ENDS OFF OUTSIDE CRANK. RETAIN CRANKS BY 14 BA WASHER OR RING OF WIRE SOLDERED TO SPINDLE.
BRACKET POST AND BASE S10

ASSEMBLY DETAILS 0-GAUGE UPPER QUADRANT SIGNALS
(Walkers & Holtzapffel Ltd.)


S/L 2 (H OR D)
2 ASPECT SEARCHLIGHT
C/L 2 (H OR D)
2 ASPECT
C/L 3
3 ASPECT
FITTED WITH JUNCTION INDICATOR RIGHT OR LEFT
C/L 3JR. C/L 3JL.
C L 4
S R. TYPE 4 ASPECT
S/L 2 W (H OR D)
G W R 2 ASPECT SEARCHLIGHT
USE SPECIAL POST ASSEMBLY CA-3
FOR COMBINED HOME AND DISTANT
COMMON NEGATIVE EXCEPT WITH HEADS C/L 3J AND C/L 4 WHEN THIS PIN IS TO BE USED FOR 4TH ASPECT AND NEGATIVE EXTERNAL CONNECTION IS MADE TO RET. PLATE
SOLDER BOSSES ON CASTING TO RETAINING PLATE — USE A MINIMUM OF NON-CORROSIVE FLUX
YELLOW
FRONT
RED
GREEN
UNDERSIDE OF BASE STANDARD POSITION AND CONNECTIONS OF PLUG
THREAD LEAD THRU' POST AND CEMENT FERRULE
SPOT SOLDER
STANDARD HEIGHT 90 MM.
POST BASE AND PLUG ASSEMBLY CA-1
LADDER AND GALLERY CA-2
SOLDER LADDER TO RETAINING PLATE
SOLDER LEADS AT TIPS OF PINS USE NON-CORROSIVE FLUX
NO PLATE 6MM x 10MM SOLDERED USE WITH S/L HEAD ONLY L.M.S. NO IS PAINTED ON TARGET
"P" SIGN AND 'PHONE BOX CA-6 CA-7 SOLDER OR CEMENT TO POST — STOP SIGNALS ONLY
1 0 1 2 3 4 5
INCHES (O-GAUGE)

ASSEMBLY DETAILS 0-GAUGE LIGHT SIGNALS
(Walkers & Holtzapffel Ltd.)

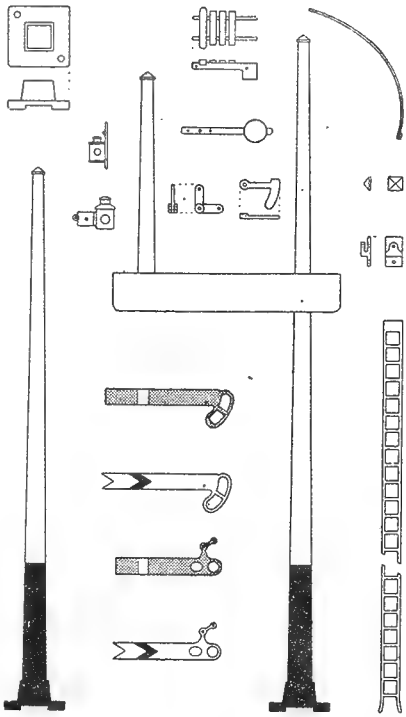


0-GAUGE SIGNAL PARTS (Walkers & Holtzapffel Ltd.)

THE LOCATION OF MINIATURE SIGNALS

The Block System, which has since its inception undergone numerous modifications and improvements, is the basis of all modern railway signalling. It involves the division of the line into blocks, each block controlled by a cabin and a set of signals, and each block related to the next by means of bells in the cabins. Every distinct block is governed by a home signal and a distant, the home signal being placed immediately in front of the beginning of the block, the distant signal being placed at least a full train length ahead of it in order to indicate to the driver what is the position of the semaphore on the home. The bells give the signalmen

the indication as to whether the track of the block ahead is vacant ; the code of bell-rings is very elaborate and covers a large variety of messages. It will be apparent that on a miniature system, operated by one person who is not riding on the locomotives, many of the phases of block signalling are impracticable. Nor is there ever sufficient expanse of main line to allow for the placing of all distant signals without rendering the layout a mass of signal posts and gantries. The bell code is completely useless since there are no men in the cabins to hear. And if the operator could be guided by bells he would need 500 pairs of legs to obey them all, while keeping the trains moving at the same time.



0-GAUGE SIGNAL PARTS
(Basset Lowke Ltd)

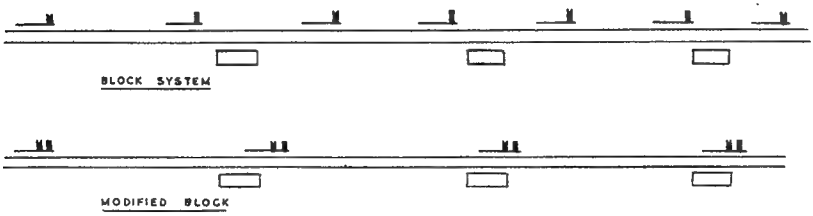
It therefore becomes necessary to adopt the block system with as many modifications and prohibitions as are incidental. Many designers exclude all distant signals. Others work by the method of reducing the number of blocks on the main line to an absolute minimum. But this does not entail any relaxation of the stringent rules of signalling practice, which may be tabulated in an elementary manner as follows :—

A home signal required at every location where more than one train movement is possible ;

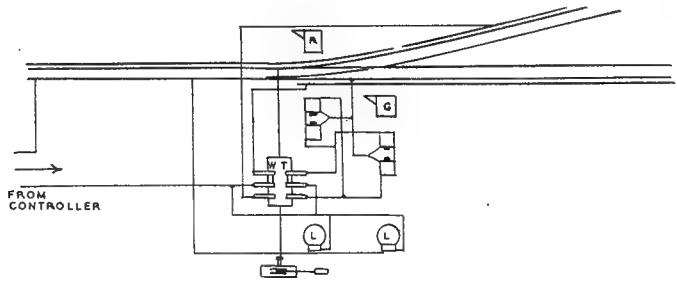
A distant signal required at every location where indication is to be given as to the condition of a signal ahead ;

Advanced signals required at every location where a limited journey into a prohibited block is demanded for a very short distance only, and where such a journey can be taken with safety.

Starter signals required at the out-going end of every platform track in a station.



BLOCK AND MODIFIED BLOCK



SIDING CONTROL

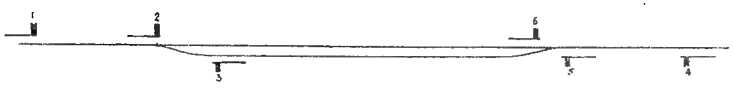
Platform entry signals required for every separate platform of a station.

Signals governing facing points MUST be placed far enough ahead of the point to permit the stopping of a train after passing the signal and before reaching the point.

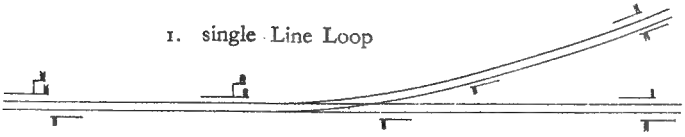
Siding signals MUST be interlocked with the points which allow trains to pass out of the siding.

All signals must be in such a position and of such a height as to be visible from the cab window of a locomotive.

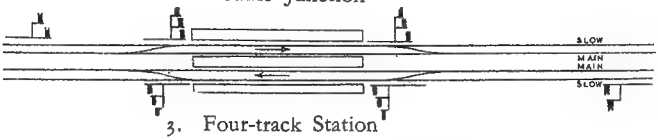
Let us proceed to a few examples. The first signal location diagram shows the signalling of a series of successive blocks on a main line. Each block has its distant, its home and its starter, the blocks being divided by the position of the cabins. A possible method of eliminating numerous posts on a layout would be to place the distants on the same post with the homes of the previous section and to allow the homes to function as starters also. These are factors for the worker to settle for himself, with as little departure from real procedure as possible. Much depends upon the size of the layout. In the next diagram we have a plain single-line loop, such as might occur at a station, where trains operate in both directions. It should be noted for purposes of interlocking that signals 2, 3, 5 and 6 cannot be " off " at the same time. Next we have the signalling of a double junction,



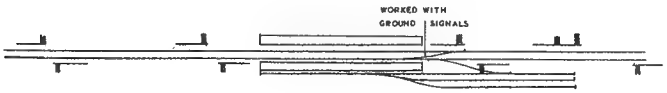
1. single Line Loop



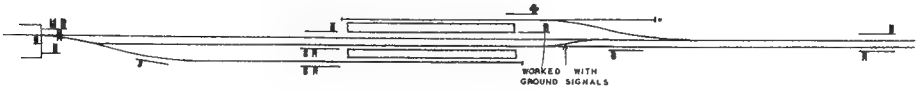
2. Double Junction



3. Four-track Station



4 Passing Station



5. Passing Station

SIGNAL LOCATION

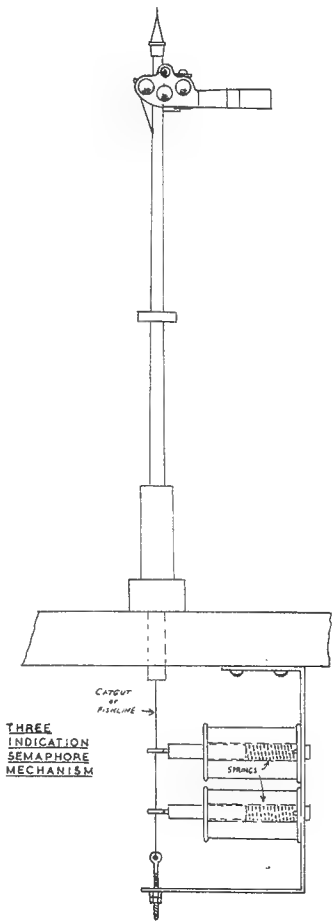
with distants, homes and starters for each of the up- and down-lines. A four-track station is next shown, where the up-and down-lines are in pairs and side by side. The third arm on each of the gantries serves the cross-over, over which trains pass from main to slow or slow to main. At such a station there would also inevitably be sidings which would be governed be dwarf signals. Three further station arrangements are given, the final one being the layout at Laurenceton on the former West Midland System owned by the writer. Here there is somewhat of a complication of tracks for which the full signalling is given.

SIGNALLING

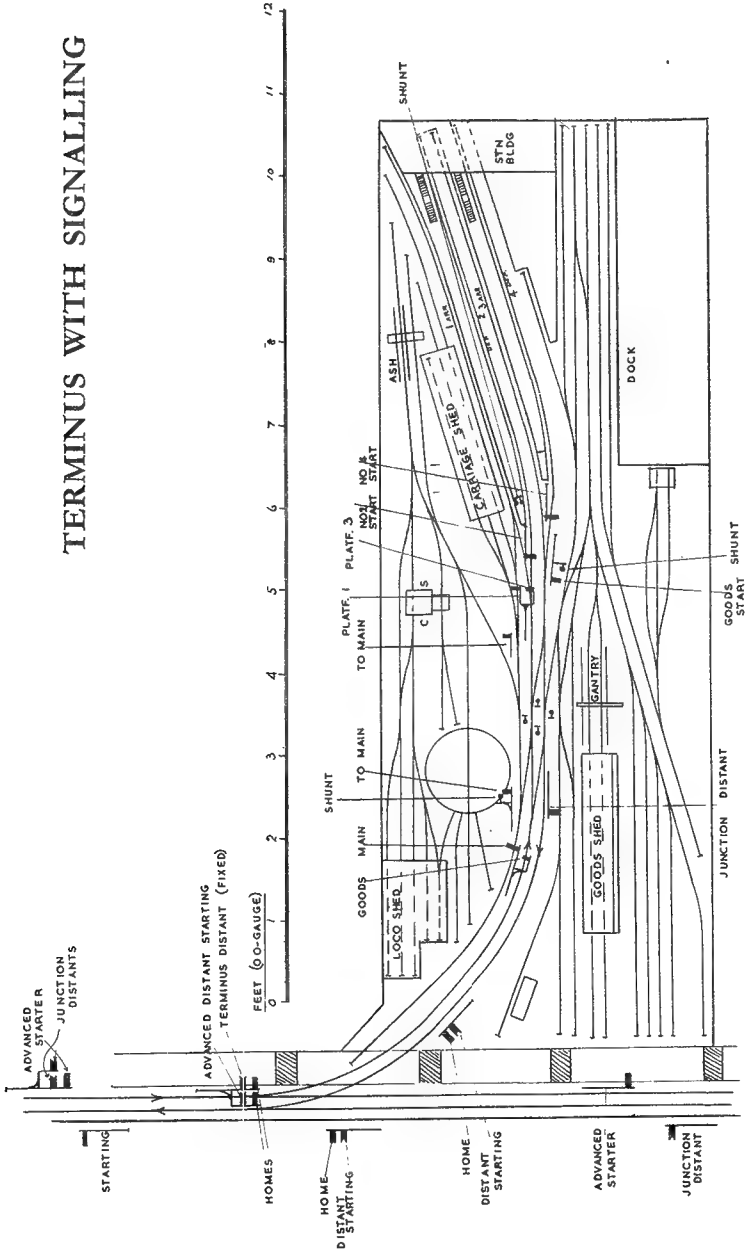
SIGNALS FOR YARD OPERATIONS

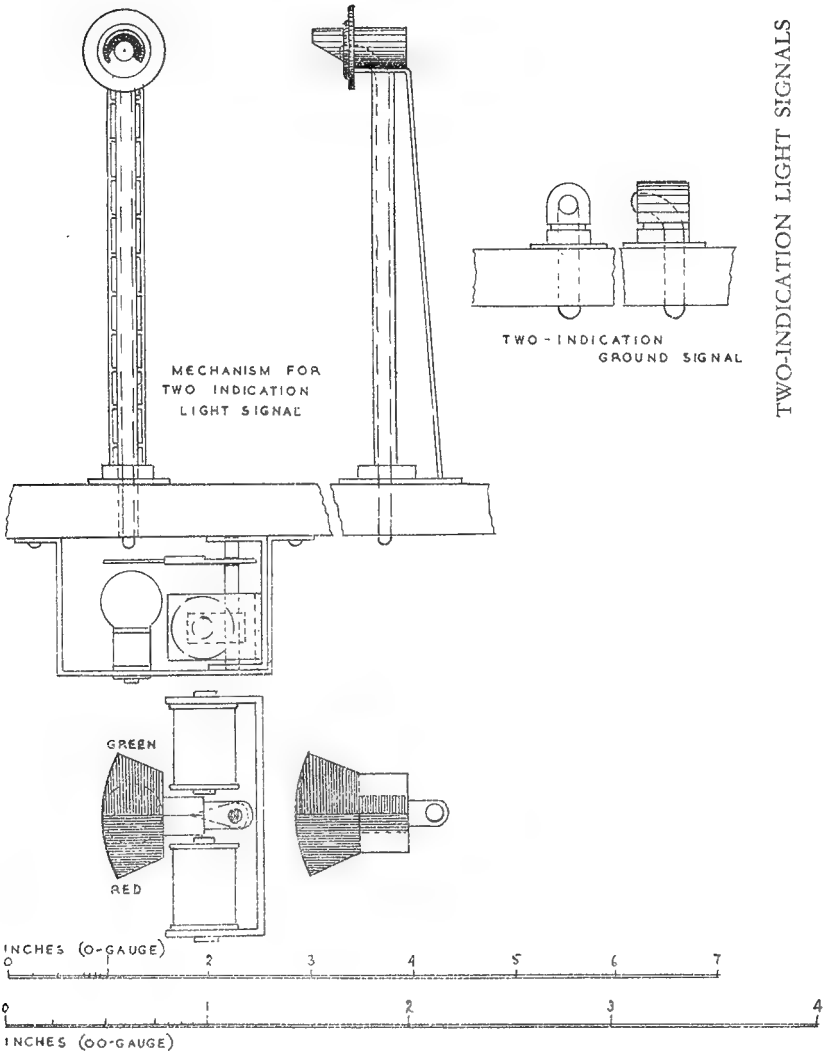
It is recommended that for goods and other yards the type of dwarf signal should be of the colour-light kind, since this involves nothing in the way of cramped mechanical arrangements. To make a working semaphore of the dwarf variety in 00-Gauge would be a work of art indeed; but if the principle of reflected light is adopted, as for standard colour-light signals, there could be nothing much more simple. It may be mentioned that complete signals of this kind can be had in America both for 0- and 00-Gauge from the Pioneer Company of Chicago, though there is no British type at present on the market. It is a very easy model to make, however, and a full drawing is given, the form of mechanism being the same as for the post signal beside it.

A diagram for the wiring up of such a signal is also included (page 54), where the signal is applied to an ordinary siding for which it also controls the locomotive power supply.

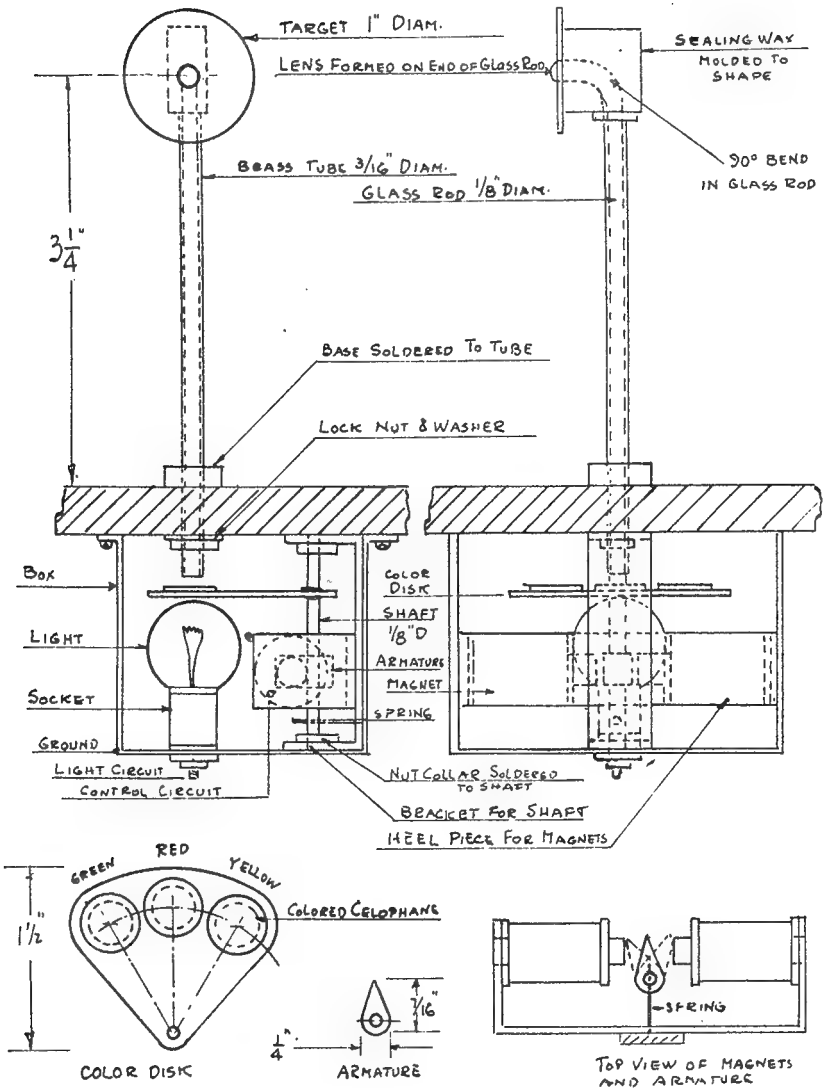


TERMINUS WITH SIGNALLING





INDIRECTLY LIGHTED SIGNALS



THREE-INDICATION LIGHT SIGNAL

SIGNALLING

SIGNALS OPERATED FROM THE MAIN SWITCHBOARD

It is good to know that even in these difficult times there are several firms producing or about to produce excellent ranges of semaphore signal parts—semaphores, posts, signal lamps, ladders, finials, bases, back-shades, cranks and bearings—both for 00-Gauge and 0-Gauge. Hamblings, Zenith, Walkers, as well as Bassett-Lowke and the Leeds Model Co., should be consulted, and several of the various lines are illustrated. Walkers have just produced an excellently detailed 0-Gauge signal as a finished model, and Zenith Models promise before many weeks a limited range like the once-famous Merco-Midland electric signals in 00-Gauge. The making-up of the various types by using commercial components is a very simple matter, and it is scarcely worth the labour to produce these parts in the home workshop. The American firms are also lavish in their provision, and although American signals have often their unique outward form, it is possible to use various accessories in the construction of British-type units. In both countries there are complete ranges for both upper- and lower-quadrant types.

A couple of diagrams (page 44) will serve to illustrate the method of constructing the magnet-operated type of upper- and lower-quadrants. For the single-post type, the post itself may be of either wood or brass, and will have a better appearance if slightly tapered, though this is not essential. Brass is the preferable material, since the post can be more readily attached to the baseplate with solder. For bracket signals the sub-structure of the bracket may be soldered up from fine strip metal. For the mechanism below the base, magnets from discarded bells may be used, but should be rewound with 38 S.W.G. enamelled wire (about 2,500 turns). The important item is the securing of free movement on the small tinplate armature, and the use of stiff but fine wire for the operating cables. Angle-cranks may be soldered to the posts as indicated. These, along with the semaphores, lamps and brackets and finials, are commercial accessories. It should be noted that the scale included applies only to the post-semaphore signals in the drawing.

The history of the colour-light signal as applied to model layouts

is very interesting. For some years it was considered impossible to model these items for 00-Gauge except as dummies, owing to the fact that miniature bulbs could not be produced small enough to be accommodated within the tiny lamp-enclosure. The first attempt at an indirectly-lighted signal in this country was made, I think, by Mr. W. R. Walkley, and had for its main idea the borrowing of rays by means of minute mirrors within the lamp-enclosure from full-power lamps in service for the lighting of the room. Change of colour was secured by means of moving vanes within the lamp-housing of the signal. A development of this idea was the placing of the light beneath the baseboard or behind retaining walls on the layout, and the directing of the rays therefrom to similar mirrors set at the precise angle to reflect the light through a lens. The notion of using a glass rod enclosed within the post, with its upper and lower ends exposed, the lamp being immediately below the rod, was probably American in its inception. It is, at all events, a most excellent and ingenious scheme, and can, by the use of suitable moving vanes be adapted to either two-indication or three-indication lights.

The diagram given to depict the three-indication model, page 55, was made by Mr. W. K. Walthers in 1934, and appeared in the *Model Railroader*. It shows the details in an admirable manner for a 0-Gauge signal. The glass rod can be had from any dealer in laboratory equipment and it is bent under its own weight with the heat of a bunsen burner, the bend being required without kinks. The rod ends are then shaped to form a lens as shown. The housing at the signal head is formed of hot sealing-wax, to which the target is pinned before the wax is hard. The forming of the small armature for the magnets is very important, and is perhaps the most laborious item in the structure. Any lamp, to the voltage of the railway, will serve, and discarded bell magnets are used for the operator. The model of the two-indication unit is even more simple, the scheme being the same as the foregoing, with the substitution of a more easily made vane. The increased heaviness of the post is due to the lack of commercial glass rod of a finer calibre than one-eighth inch. But in order to keep down the thickness of the post, the rod might be wrapped with black gummed paper.

The popular American "Indian Head" mechanism is designed to serve the dual function of operating a signal vane and as a relay for the track-section current. This appliance is retailed by the Pioneer Co. of Chicago. The machine employs a single coil designed for continuous duty with direct current. The coil units are interchangeable, and the mechanism can serve as a point operator, a relay and a signal indicator

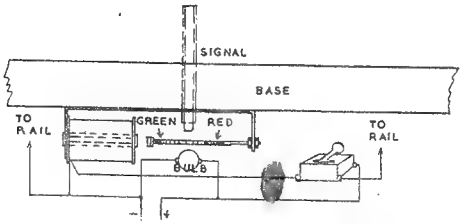
at one and the same time. Ample provision is made for all manner of adjustments to various point-operating requirements. The same firm also produces a cheaper form of signal-vane operator using the same standard coil as the foregoing. The coils in both instances can be had for either 6-volt or 12-volt service.

The cheaper form of mechanism is used in the first of the wiring diagrams to be described. This circuit diagram is one of three which I have selected from the various Pioneer schemes for operating miniature light signals. They may, of course, be applied to any form of vane-operating machine. The first scheme for use with two-indication signals is known as the Electro-Mechanical. The mechanism of the signal is controlled from the switchboard by means of a toggle switch, an S.P.D.T. (single-pole, double-throw), and is so wired that the other throw of the switch will control the track circuit which the signal protects.

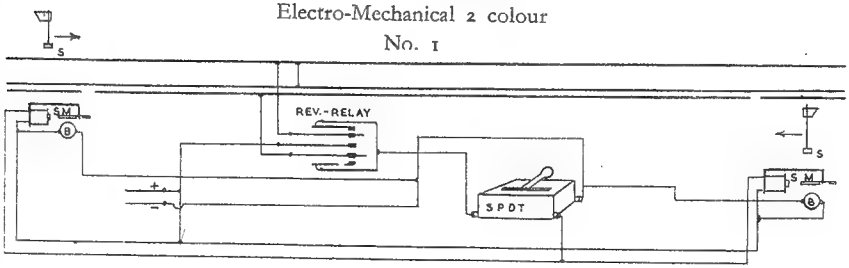
An alternative two-indication scheme is that of the next drawing, the Semi-Automatic Single Block system. This is arranged for single track where traffic moves in both directions. The distinction between this semi-automatic scheme and the fully automatic is that it can be applied to a single block or section of the track, whereas the fully automatic system requires at least three such sections. With a single block of this kind, suitably insulated, a train can be made to enter and if the signal indication is green, proceed through ; if red, the train will stop. On changing the indication, the train will continue its journey. The arrangement is especially useful at stations, goods sidings and yards.

Three-indication colour-signals may also be operated from the switchboard, and the Semi-Automatic Single Block Three-Colour diagram will show an excellent method. Here, in place of the movable vane beneath the baseboard, three separate and vari-coloured bulbs are used, arranged in a cluster, and so positioned as to focus with the glass rod. Two S.P.D.T. toggles are used, and the current to the tracks, when the indication is yellow, passes through a suitable resistance block for slow speed.

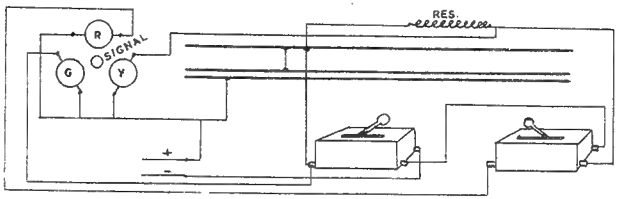
A further system, which has possibilities of wide development and application is one of the writer's own devising, and appears on page 35 in connection with the four varied methods of sectional control, covering, in this instance, the interlocking of current for locomotives, point operation and signals of the semaphore type, and having two indications. The scheme is applicable to two-way running on single track. A common point-machine is used along with a couple of Walthers' tie-rod switches (WT). Track-power leads are drawn heavily. The system is semi-automatic, employing as it does four single-throw single-pole switches on



Electro-Mechanical 2 colour
No. 1



Semi-Automatic single block 2 colour
No. 2



Semi-Automatic single block 3 colour
No. 3

PIONEER SIGNAL CIRCUITS

the control board. These are lettered WS (Westbound Switches) and ES (Eastbound), M and B signifying "main" and "branch." C is the main controller, and the circuits are so arranged that the setting of any one of the switches automatically sets the required signal and interlocks the rest.

It may be mentioned that colour-light signals of the glass-rod type are obtainable from the Pioneer Co. of Chicago and from Walkers of Baker Street, London, for 0-Gauge, as well as from the former retailers for H0- and 00-Gauges. By the use of these finished models a good deal of labour can be avoided in the making up of the completed signals.

SIGNALLING

THREE-INDICATION ELECTRIC MECHANISM

The reader may have wondered how it is possible to operate three-indication semaphore signals by electrical power in miniature form. As long ago as 1918, when in Jamaica, the writer, with the collaboration of Mr. Leslie Ridings, devised the method shown in a diagram (page 52), a strange coincidence being that exactly the same scheme was evidently worked out by W. K. Walthers in America, though some years later. I am not quite sure how Mr. Walthers arranges the return springs of the operating solenoids, the method indicated being our own. The principle is that of drawing aside a length of catgut to the required distance to give one indication, then drawing it further to give the second. An adjusting loop at the foot of the mechanism makes adjustment most simple. The coil springs within the core of the solenoids should be of extremely light tension —just enough of a spring to keep the catgut straight and free from slackness when the signal is in its normal position. The method can be applied either to upper- or lower-quadrants. A good, full winding of No. 26 wire is necessary for the coils, in order to avoid over-heating, though it must be borne in mind that the " caution " and " off " positions of the arm are not likely to be maintained for many seconds at a time with track circuiting.

The wiring of this type of signal, like that of the three-light colour-vane example, will, for track circuit block work, be identical with the Pioneer semi-automatic single block system, the blocks or sections being of the standard arrangement instead of single, signal coils being substituted for the bulbs, and the red bulb with its wiring being omitted.

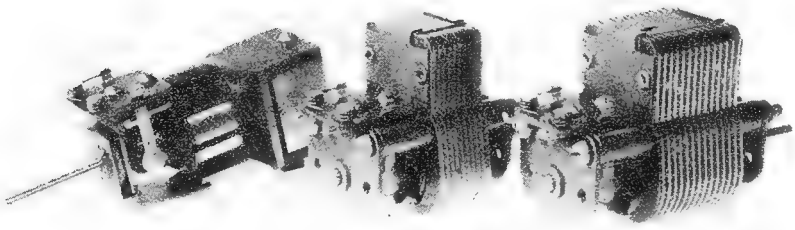
ELECTRIC HAULAGE

LOCOMOTIVE MECHANISMS

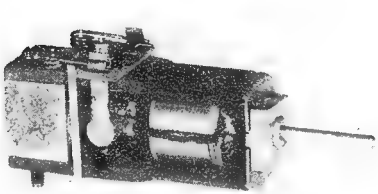
WE PASS ON to the subject of locomotive mechanisms and motors, which in pre-war days presented a wide field. It has not yet been possible for the British commercial houses to get back into their normal stride in the matter of production, but it is gratifying to see the efforts that are being exerted. A considerable amount of good work is also being carried on in this department by amateurs, while the Americans, being subjected to far less impeding controls, are moving rapidly ahead. If the reader is able to get into touch with any American enthusiast who works in British designs, it is a simple matter to exchange British goods for American, and in America there is a wide range of choice for the motor-buyer.

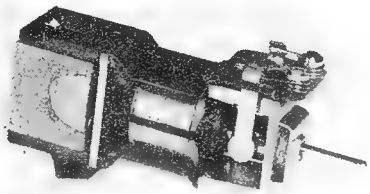
For 0-Gauge mechanisms the reader is referred to Bassett-Lowke, the Leeds Model Company, Edward Exley and Rocket Precision, all of whom are producing power units in this scale. The motor by Rocket-Precision, of Kilburn, is a fine piece of work, with gear-box to fit almost any type of superstructure, and having great hauling power. Pittman motors, produced in America, are world-famous, and they cover both 0-Gauge and 00-Gauge. For 0-Gauge there are three styles—one to fit very small models, one for medium designs, and a third for maximum power and endurance. All these have seven-pole armatures, and in price they are most reasonable. Varney has recently produced a splendid mechanism as part of the kit of a fine 0-Gauge 4-6-0 tender engine. Unfortunately, at the time of this writing, the market in 0-Gauge mechanisms is on the whole considerably more restricted than that of 00-Gauge. But there are evidences that this is a condition which will speedily be improved.

The well-known Romford motors for 00-Gauge are again on the market, and the design has been extensively improved. A new form of magnet has been introduced, of great power, and occupying the minimum of space, so that the most difficult of locomotive types are accommodated.

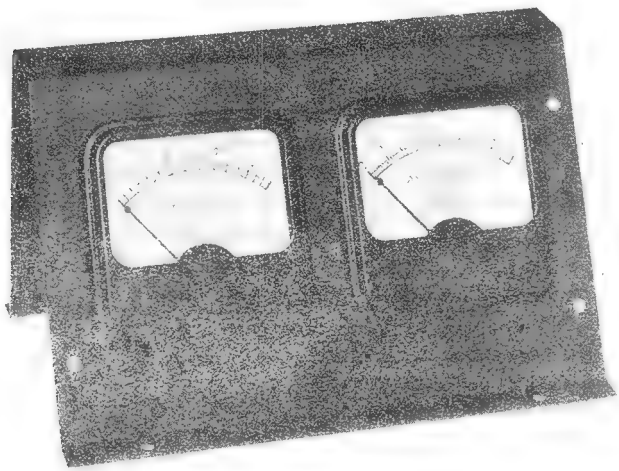


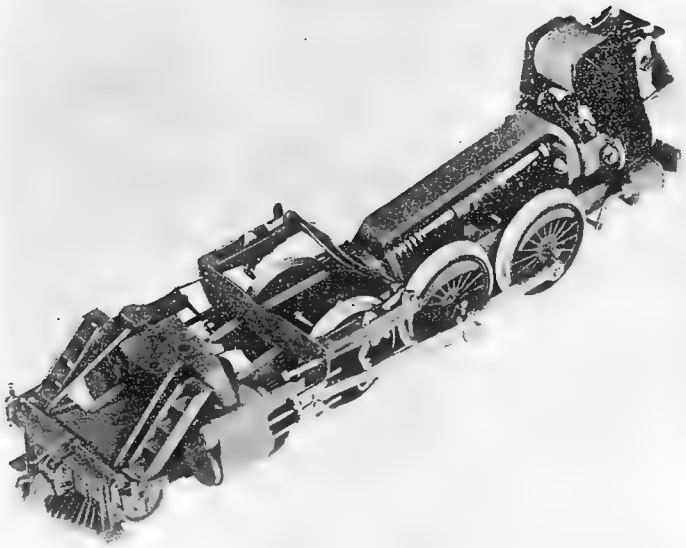
PITTMAN MOTORS (Left) D.C. 91, 12v D.C. 7 pole
(Centre) D.C. 92, 12v D.C. 7 pole (Right) D.C. 93, 12v D.C. 7 pole
(Below left) D.C. 60, 12v D.C. 5 pole (Below right) D.C. 71, 12v D.C. 5 pole



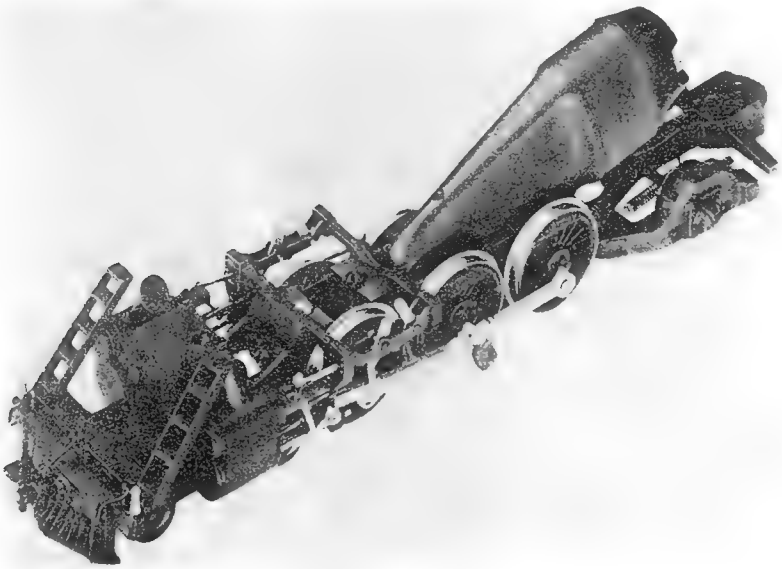


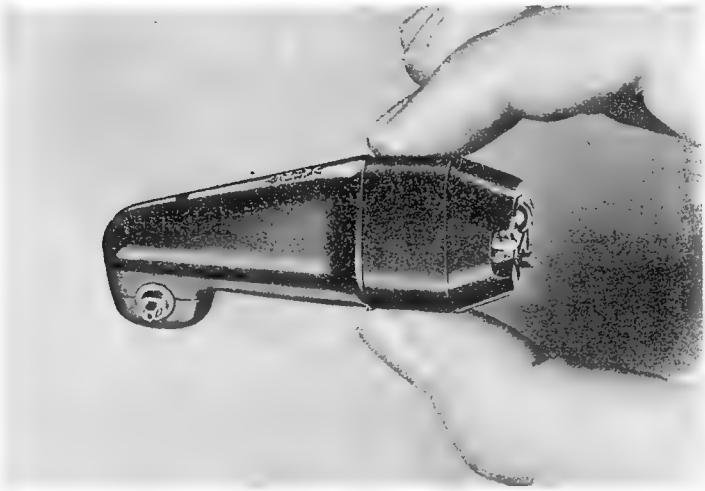
PITTMAN METRE PANEL (below) 0-5 amps ammeter 0-15v voltmeter





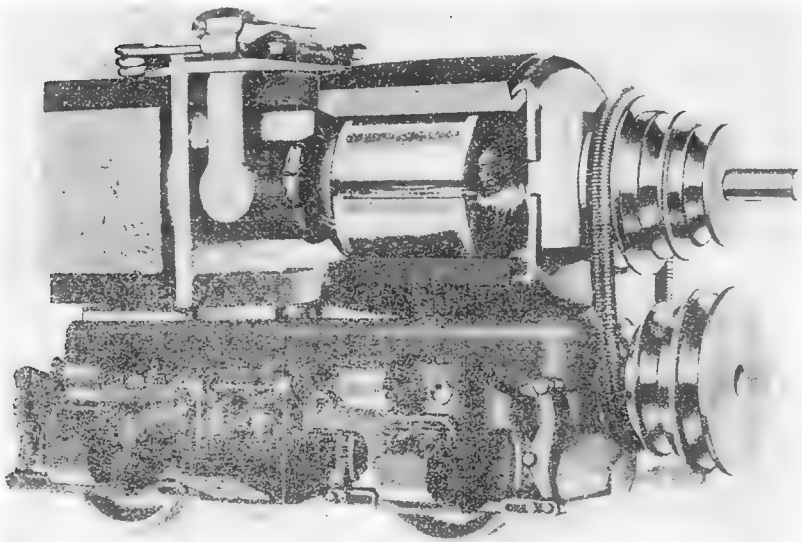
VARNEY MECHANISMS (above) 0-Gauge 4-6-0 (below) Pacific H.O.

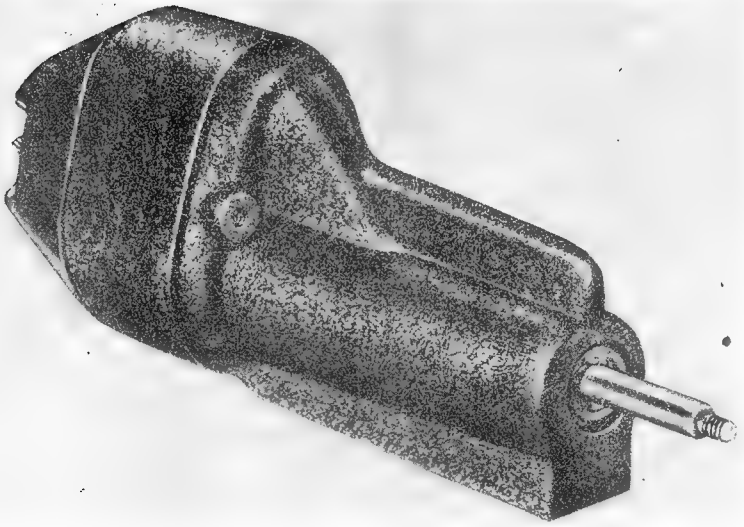




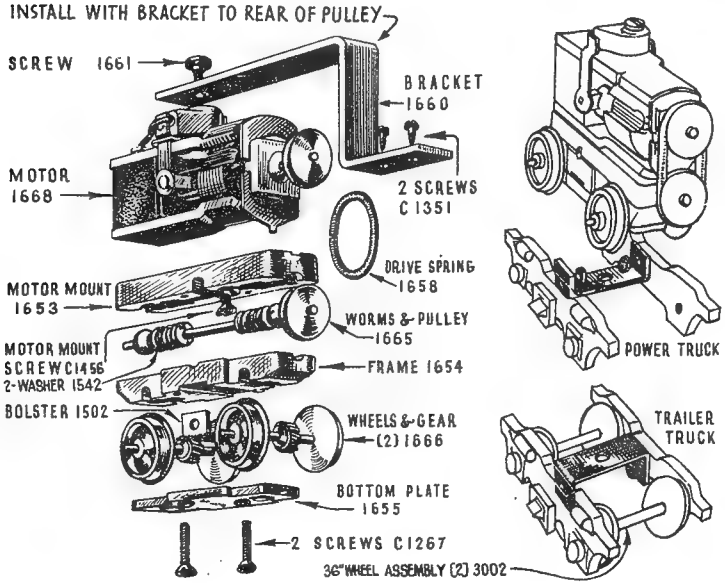
(above) VARNEY ENCLOSED 7-POLE MOTOR for H.O. Gauge Locomotive (sidedrive)

(below) VARNEY H.O. Coach and Diesel Power Bogie

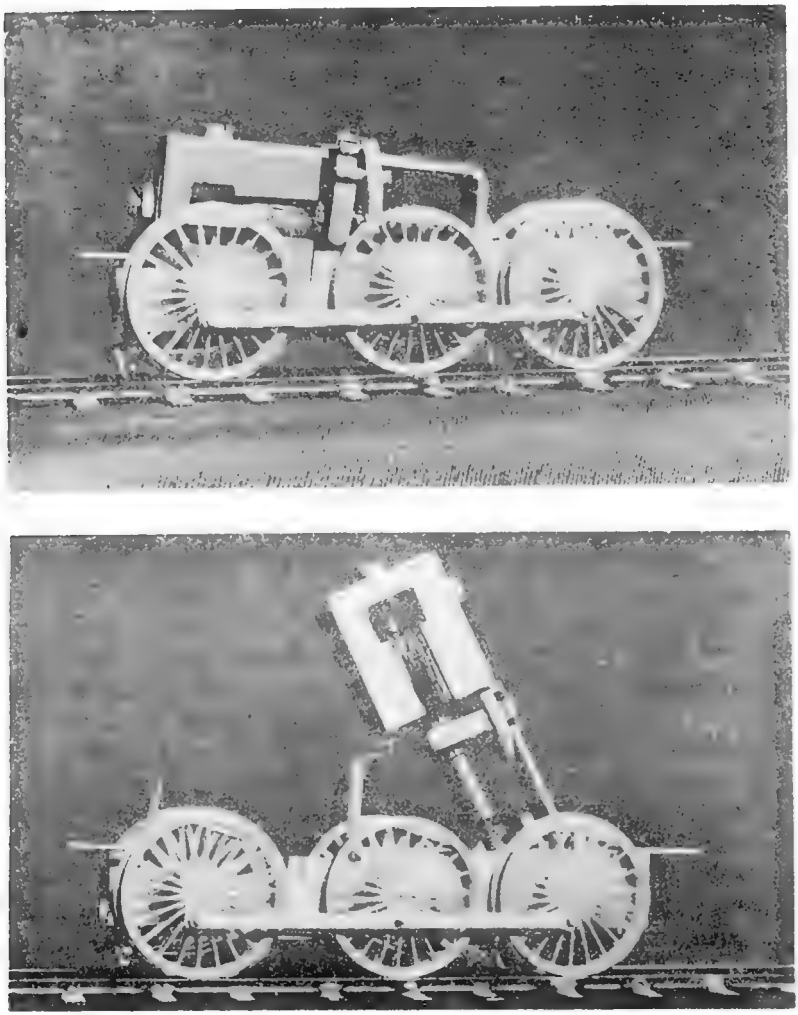




(above) VARNEY ENCLOSED 7-POLE MOTOR with end drive



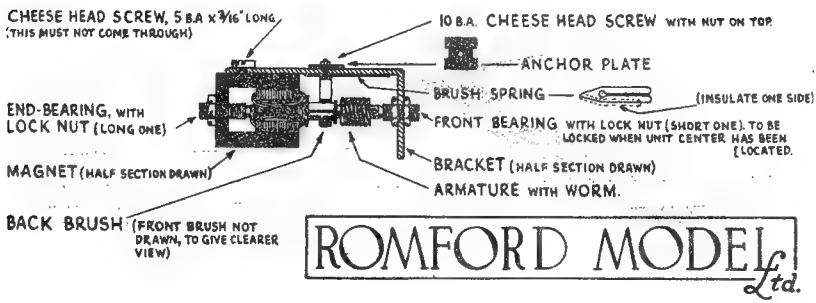
VARNEY POWER UNIT (H.O. Gauge) METHOD OF ASSEMBLY



TWO VIEWS OF ROMFORD MECHANISM FOR 00-GAUGE

The brush arms are instantly detachable and interchangeable, the chassis is assembled with screws throughout. An outstanding improvement is that the armature shaft now runs in hardened pin-bearings, adjustable at both ends, the mechanism being also adjustable for height of body. Wheels are on squared axles, and a completely new design of collector has been fitted, having separately hinged arms. It is now possible to obtain the mechanism complete with cylinders and running gear.

ROMFORD 00 MOTOR UNIT Assembly detail


CHEESE HEAD SCREW, 5 B.A x 3/16" LONG (THIS MUST NOT COME THROUGH)
10 B.A. CHEESE HEAD SCREW WITH NUT ON TOP
ANCHOR PLATE
BRUSH SPRING
(INSULATE ONE SIDE)
END-BEARING, WITH LOCK NUT (LONG ONE)
FRONT BEARING WITH LOCK NUT (SHORT ONE). TO BE LOCKED WHEN UNIT CENTER HAS BEEN LOCATED.
MAGNET (HALF SECTION DRAWN)
BRACKET (HALF SECTION DRAWN)
ARMATURE WITH WORM.
BACK BRUSH (FRONT BRUSH NOT DRAWN, TO GIVE CLEARER VIEW)
ROMFORD MODELS Ltd.

The Zenith mechanism for the same scale is also a notable production and may be had both for Standard-00 and Scale-00. The armature is five-pole and the brush gear is unique in that the brushes are sprung across and are therefore of equal tension at all times, both brushes being also insulated. Bearings are of phosphor-bronze and are fitted with thrust balls. Three gear ratios are possible. The super-mechanism is fitted with sprung wheels and has divided coupling-rods.

It is stated on good authority that a newly designed Reidpath mechanism is also in rapid course of preparation, which will embody a number of developments on the earlier design, which was excellent.

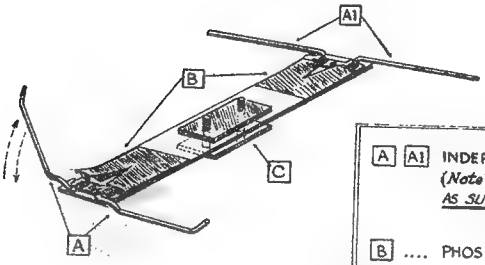
The American market has a large number of examples of first-class motor units which are suitable for the British 00-Gauge. The Varney "Little Joe" motor is an effective piece of work and is of very small proportions and great power. This motor is fitted to the locomotive which goes by the same name, and is also applied to the Varney coach-mechanism. Pittman Products have two designs for this scale, both with five-pole armatures, and priced very low. Varney has an entirely new enclosed seven-pole motor in production which should possibly take a supreme place in the market for compactness and haulage.

For coach units in this Gauge we have the Zenith (British) and the Varney. The latter as now being sold is an amazing little machine, but is being improved by the provision of side frames to suit either a Diesel engine or a shunting locomotive or a rail-coach. It is provided with a three-step pulley drive which permits a wide range of speeds. The Zenith coach unit is extremely good, and offers practically no interior obstruction to interfere with the coach windows.

Something quite new can now be obtained by anyone having access to the American market. This is nothing more or less than a reliable

THREE-RAIL CONTROL

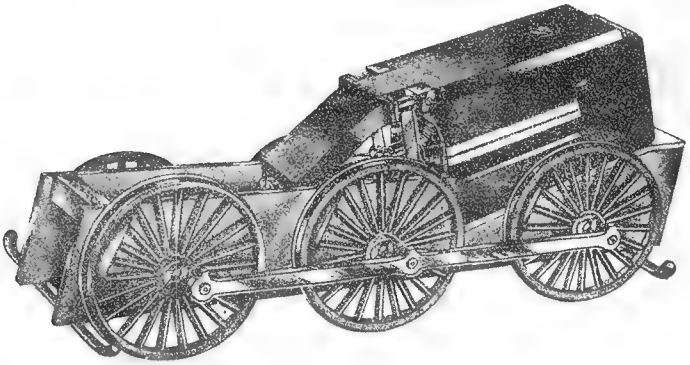
ROMFORD 00-GAUGE THIRD RAIL COLLECTOR

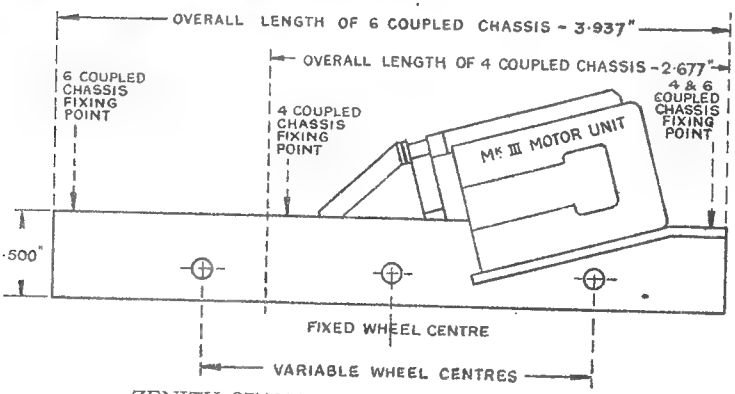


A A1 INDEPENDENTLY HINGED & SPRUNG ARMS. (Note: COLLECTOR ARMS AT A1 ARE SHOWN AS SUPPLIED, i.e. BEFORE BEING SHAPED)

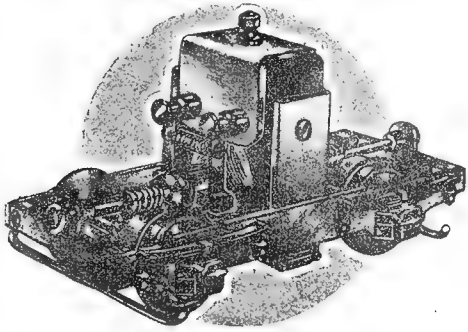
B .... PHOSPHOR-BRONZE SPRINGS

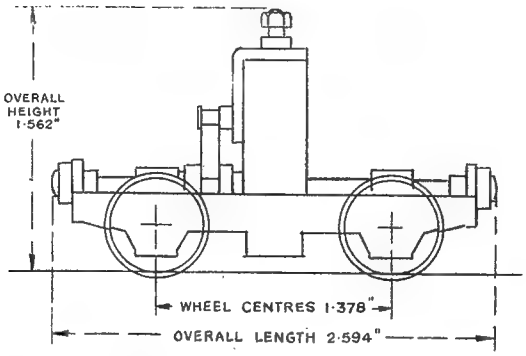
C .... INSULATING FIBRES & 10 B.A. SCREWS FOR ATTACHMENT TO CHASSIS.



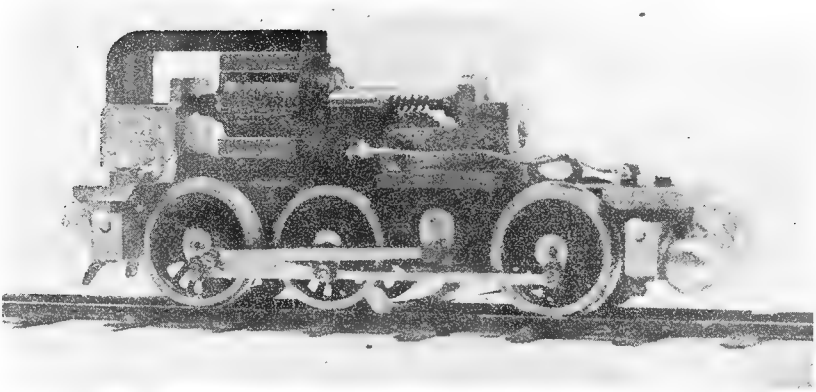

OVERALL LENGTH OF 6 COUPLED CHASSIS - 3·937"
OVERALL LENGTH OF 4 COUPLED CHASSIS - 2·677"
6 COUPLED CHASSIS FIXING POINT
4 COUPLED CHASSIS FIXING POINT
4 & 6 COUPLED CHASSIS FIXING POINT
Mk III MOTOR UNIT
·500"
FIXED WHEEL CENTRE
VARIABLE WHEEL CENTRES

ZENITH STANDARD 00-GAUGE MOTOR

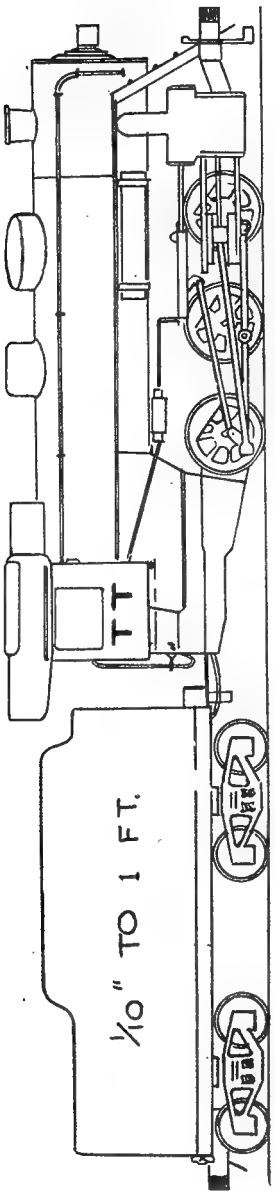




ZENITH COACH MOTOR



CHASSIS FOR DIESEL SHUNTER BY MR. MORLEY HEDLEY

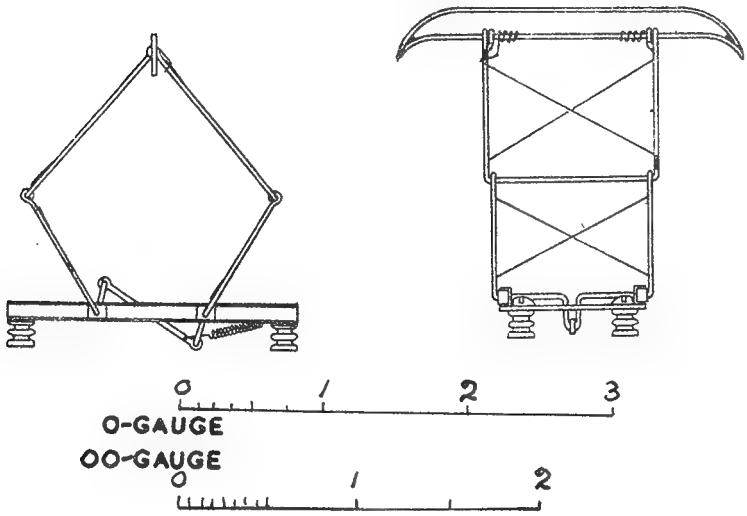


1/10" Scale Shunting Loco (Actual size)
by Harold Precision Products. U.S.A.

narrow-gauge locomotive mechanism. The firm known as H.P. Products, of Hartford, Ind., have recently brought out a standardised railway system to the sub-normal gauge of 15/32 in. (approximately ½ in.) and to a scale of 1/10 in. to 1 foot. The range offered includes two-rail track (which can readily be converted to three-rail if desired), Diesel freight and passenger engines and streamline coaches, with—what is better still for our purpose—a six-coupled freight engine of the "steam" type. The engine unit can readily be adapted to free-lance designs for quite powerful working narrow-gauge engines to the 4 mm. scale. The motor actually used is the same design as the Varney "Little Joe." The reader should see the advertisements in the *Model Railroader* and write for this firm's lists.

All the mechanisms described are wound for the newly stipulated 12 volts.

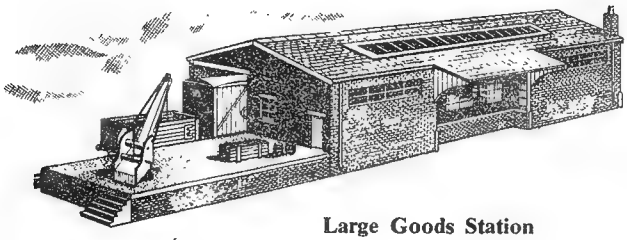
While dealing with motor power and supply, there are two further items which require mention: third-rail collectors and overhead trolleys. I am indebted to the Romford Model Company for a drawing of an entirely new design of third-rail collector which gives promise of eliminating all the earlier troubles experienced with this appliance, The drawing is self explanatory.



DESIGN FOR A PANTAGRAPH

The drawing of the pantagraph overhead collector is the work of Mr. A. C. Kalmbach and reveals in the simplest manner possible the method of construction. The four mountings for the roof may consist of small calibre brass tubing, or, if preferred, a perfect little fitting for this purpose can be had from firms selling ship's fittings. The material for making the frame is No. 16 hard brass wire. The ends of the upper frames are looped around the lower ones; springing is by means of cranks at the base, as shown. If the roof of the vehicle is of metal the appliance must be insulated by means of fibre washers.

Lineside Kits



Large Goods Station

The " Lineside " range of kits has been introduced to meet the demand for an inexpensive, easy-to-build kit of parts for railside buildings and features in 4mm. scale.

They are fully comprehensive and contain printed wood and card parts, printed acetate windows, etc., brick and tile papers, plan and full instructions.

First in the series are :—

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Country Station ...	... 5/6	Water Towers	... 2/9
Large Signal Cabin	... 4/7	Footbridge	... 2/9
Small Signal Cabin	... 3/8		

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In this book Mr. Beal presents an introduction to the whole subject for the newcomer, giving a full philosophy of the art. Suitable layouts and general planning are discussed. The reader is fully introduced to the extensive range of literature on the subject and instructed as to the sources of requisite blueprints and so forth.
Price **3/6d.,** *by post* **3/8d.**

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The author proceeds in the second handbook to get down to the actual work of designing, planning and building a layout, starting with the standard dimensions and Ministry of Transport rules. Such items as the formation of the superstructure, the provision of necessary facilities for goods, passenger and locomotive traffic and servicing are all presented from the standpoint of the writer's lengthy experience, as well as that of other well-known designers. *Price* **4/6d.,** *by post* **4/8d.**

Book 3. **Three-Rail Control.**
While it is true that Two-Rail control has deservedly captured the imagination of the railway modeller, it is also a fact that there are thousands of workers who prefer the Three-Rail system. Mr. Beal has not forgotten these people, and has furnished in this handbook all the guidance they require regarding the selection of the best switches and controllers, the wiring of points and crossings, track sectionalisation and the wiring up of a complete layout. *Price* **4/6d.,** *by post* **4/8d.**

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Number four in this series is devoted to the essential engineering features which come within the purview of the enthusiast. Every kind of bridge is described and provided with a working design. Tunnels, viaducts, culverts, iron and steel work, turntables and coaling appliances of the most modern type are adequately dealt with.
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Book 5. **Architecture.**
The scope of this book is very great indeed, and it will interest many who are not primarily concerned with the lineside scene. Not only does it include station buildings, goods yard buildings, loco accommodation and yards, tunnels and signal cabins; factories and industrial plants, villas, shops, terrace houses and residences are also shown. The author's drawings are supported with photographs of master-pieces of modelling. *Price* **4/6d.,** *by post* **4/8d.**

Book 6. **Wagons and Coaches.**
A page of diagram is worth a chapter of talk, and the man who wishes to practise this most intricate branch of the craft will find that, as he works, he will almost certainly have this book open at a page of beautifully clear drawings. Mr. Beal's impartial survey of the market of commercial parts and complete units is most useful. *Price* **4/6d.,** *by post* **4/8d.**

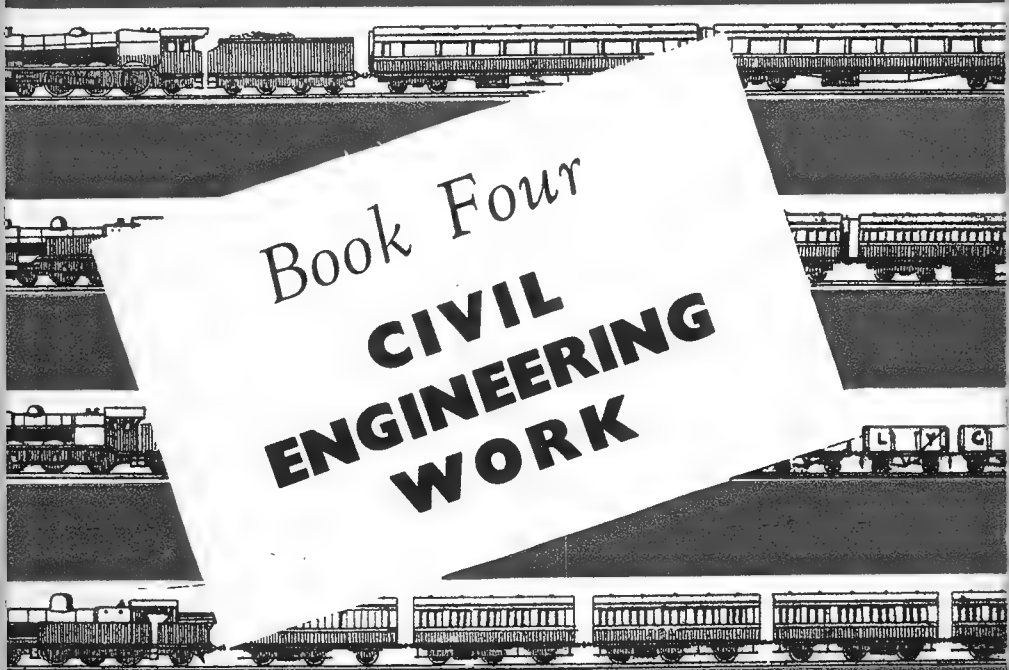
Book 7. **Two-Rail Control.**
The advantages of Two-Rail control as compared with the older Three-Rail system are fully explained and the author shows lucidly how much simpler it is to install and operate. Various methods of amateur track constructions are described and there is a complete chapter dealing with the commercial types of track available. The subject has been covered comprehensively and there are numerous illustrations.
Price **3/6d.,** *by post* **3/8d.**

Book 8. **Miniature Traffic Working.**
In this book the author describes how the rules of real railway procedure can be simulated in the operation of a miniature layout. Reading through the opening chapters, the owner of a newly-completed layout will soon realise that his work is far from finished. Such points as operating procedure, scale speeds, time-table working and so forth have all to be studied, and these, and many other interesting features are dealt with fully in the eight comprehensive chapters.
Price **3/6d.,** *by post* **3/8d.**

OTHERS TO FOLLOW

Edward Beal's

RAILWAY MODELLING SERIES



Book Four

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FIELD TO BE COVERED

CIVIL engineering work on railways covers a wide area which includes track, earthworks, retaining walls, bridges and viaducts, tunnels, structural steelwork and timberwork, mechanical appliances within certain restrictions, together with such work as that involved in the carrying of one set of railway tracks over another at a higher level. The term may be taken in a general way as covering everything of an engineering quality on railways with the exception of locomotives, rolling stock, signalling and architecture, though the denotation of the term has certain variations with different companies.

There is no reason why the scale modeller should not abide as faithfully as possible to the same broad classification, and the discussion of these various features happens also to lend itself conveniently to the series of volumes of which this is the fourth.

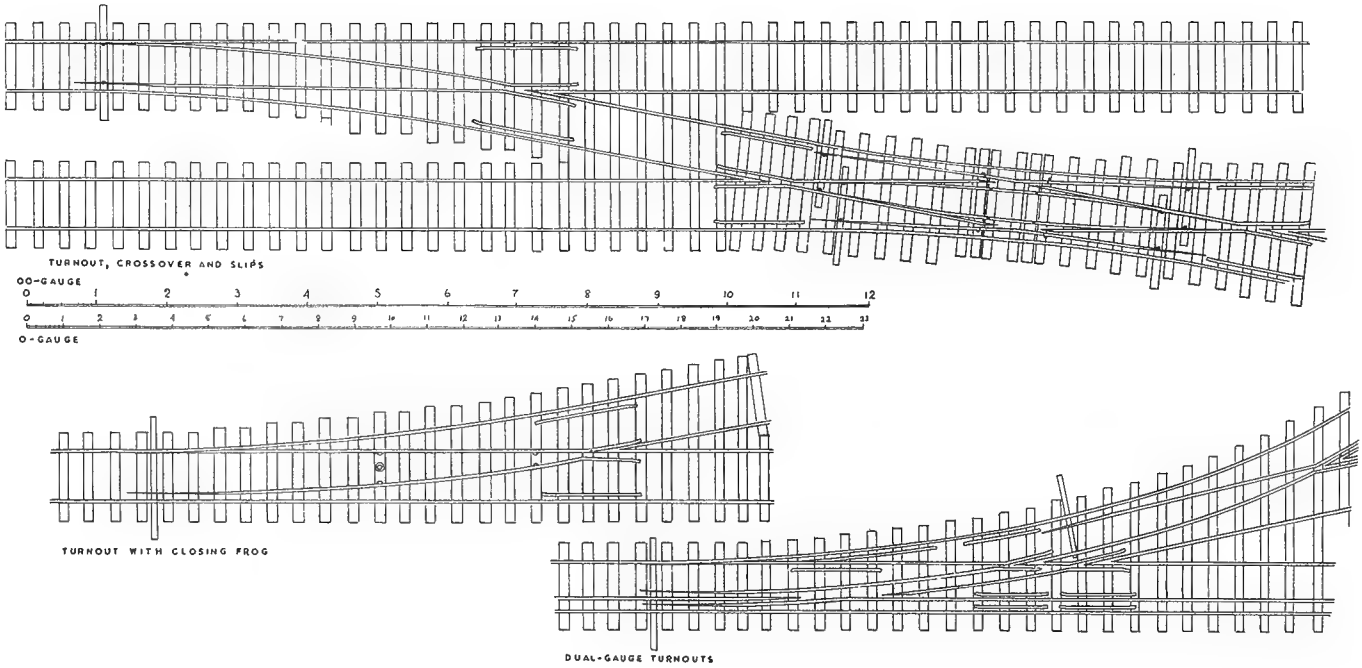

TURNOUT, CROSSOVER AND SLIPS
00-GAUGE
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
0-GAUGE
TURNOUT WITH CLOSING FROG
DUAL-GAUGE TURNOUTS

FIG. 1

TRACK DESIGNING

TRACK AND PERMANENT WAY

IN the construction of model track there are, of course, in the first place the rigid dimensions laid down by the British Railway Modelling Standards Bureau to be observed. Workers on layouts of the American style will also require to abide faithfully by the similar proportions stipulated by the American Bureau. These standards, as touching British work, have already been referred to in an earlier volume.

Our first drawing gives an idea of the various track arrangements and points in a form as concise as possible. In the upper diagram we have the plain track, a turnout, a crossover and a double-slip. These follow the approved methods of design and construction. In the drawing, lower left, we have a turnout with a closing frog—an idea enjoying increasing popularity in model work. The advantage of this idea lies in the fact that when the points are set for a given direction the wheel-path throughout the selected road becomes an integral and unbroken runway, without the sometimes troublesome gap at the frog. The method of construction is simple in the extreme; the moving unit of the whole point is made in one piece by means of three links—the tie-rod, the centre swivel link (which takes a pivot) and the short connection at the frog-end. The idea is applicable to three-rail or to two-rail, and in the latter instance, of course, the question of insulation will arise or not according to the method of current-supply adopted.

For the guidance of those who propose to run narrow-gauge as well as standard-gauge stock, the drawing on the lower right gives the arrangement for a dual-gauge turnout. Of such points there would be few on such a layout; they would occur only at those locations where the narrow-gauge roads are linked up at stations and depots with the standard-gauge so as to form a two-gauge track. The position of the various check-rails must be carefully observed in this construction.

The spacing of sleepers is an optional matter within certain limitations; but the designer will do well to provide plenty of them. The best of track will be ruined by over-spacing, and the cost of including the scale number of sleepers, though an item, is well-invested expenditure.

Fortunately, there are on the market complete ranges of components for all forms of track, though individual items are from time to time in a state of scarcity. We will therefore deal first with the old type of metal

track (non-insulated) as used on the smaller gauges for three-rail power supply. In doing so, it may be mentioned that there is really little advantage in adhering to the use of this construction, since the insulated two-rail track is easier to make and is as conveniently adaptable to three-rail as to two-rail supply.

The accepted method of construction is by means of the wooden track-jig depicted in the second figure. For straight track this consists of a straight strip of wood about 1¾ in. wide by ⅜ in. in thickness, having at regular spacing intervals small blocks of wood sprigged and glued on its surface. These blocks are all exactly 16.5 mm. wide and of the width (in the other direction) of the desired gaps between sleepers. They are spaced on the board so as to allow ⅛ in. between each block for the sleepers, and they must be laid with absolute accuracy. The upper drawing shows this straight jig with a length of track extending half-way along it, and with five sleepers laid in place awaiting further rail.

Proceed to set in one sleeper carefully at each 6 in. or so, then fill in the spaces, soldering all one side first, then turning the jig around and soldering the other. With a little care and practice, it is possible to make a yard of this track with a soldering iron as described in about 20 minutes.

When finished see all sleepers are firmly soldered, then remove the length, clean off the flux and paint it dead black on a piece of cardboard all over, including the insides and outsides of the rail webs. Then, while the paint is wet, rub off the top of the rail with a piece of rag. When dry, take a fine piece of sandpaper and polish off the top edges.

Curves are made just in the same way, but only one rail is soldered in place before the length is removed from the jig. Fig. 2 (B) shows how this is done.

The second rail is added in the manner indicated in (D). That is, a cardboard template with an arc of a circle of 24 in. radius is pinned to the table with three drawing pins, the length of track slipped underneath it till the soldered ends of the sleepers are covered. Then, with the aid of a piece of ⅝-in. lath about an inch long as a gauge, the other rail is soldered in place. The 1-in. length of lath will ensure that the curve is made slightly over the true gauge, which is as it should be.

We next come to crossovers. For this work it is quite possible to use the same jig, though a lath of ⅝-in. stripwood ¼ in. thick will also be used. It should be about 18 in. long. Your main trouble will be over the first crossover. When that is done, you can make the rest by setting the frogs while the new work is laid over the finished point. Stick to the same curve template for your crossover angle.

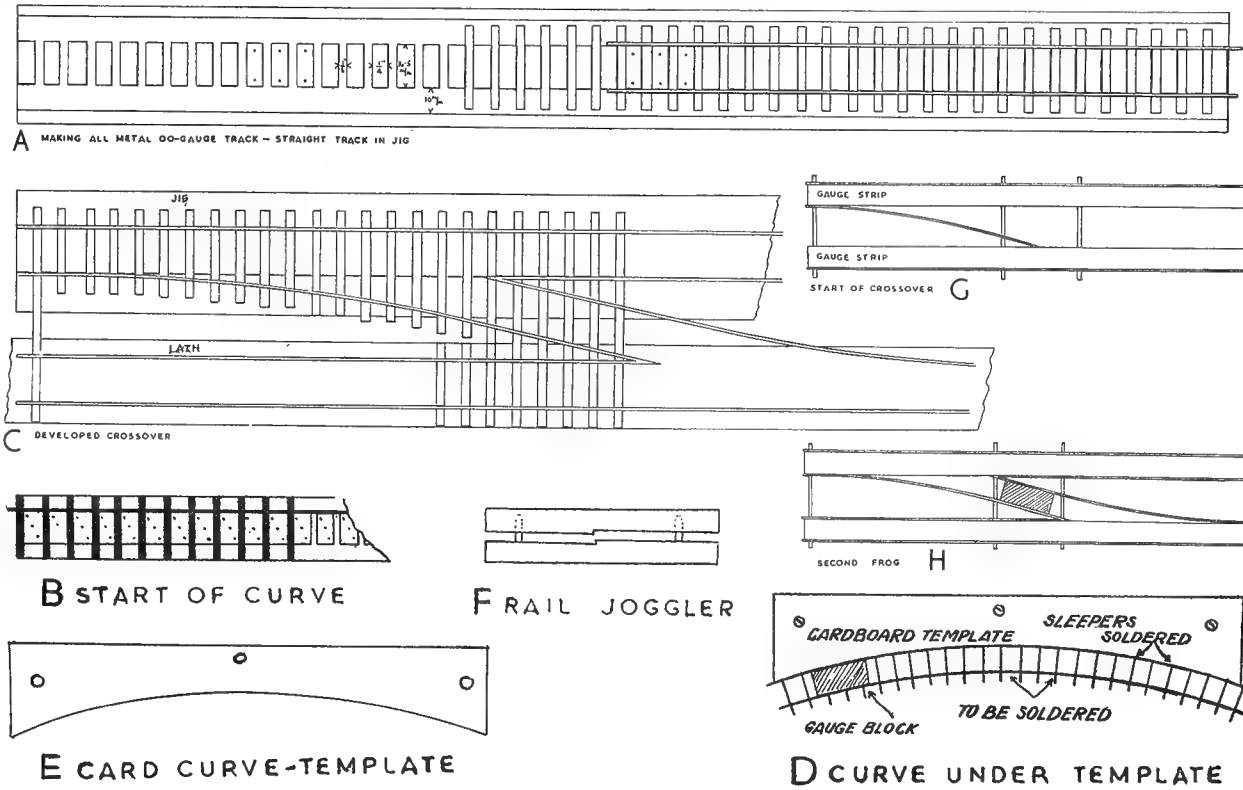


FIG. 2 MAKING METAL TRACK FOR 00-GAUGE

Begin by joggling the ends of the stock-rail which is to receive the blade of the point. For this, it is good to make a joggler [Fig. 2 (F)] from two pieces of iron simply filed as shown. These are set one on each side of the piece of rail and the whole squeezed in a strong vice. This will kink the rail and form a recess for the blade to sink into, which will effectively avoid derailments. Next file up the ends of your switch-rail blades and your frogs.

Do this with a common file on a block of wood. The switch-blades should be tapered right down to a feathered edge, and the taper should be about 2 in. long. The frogs are filed at a much sharper angle and on one side only.

Now take a long sleeper and one of your kinked stock-rails (for a crossover). Using the lath, solder the sleeper at one end, with $\frac{1}{4}$ in. projecting. Now solder another at the other end, and two more just at the place where the two frogs come [see Fig. 2 (G)]. Then solder in the stock-rail for the other track in just the same way, leaving $\frac{1}{4}$ in. of the long sleepers projecting.

The six-foot way is $1\frac{1}{8}$ in., and the sleepers are exactly right for this dimension. Next take the lath and set in the first straight frog-rail, tight up to the lath, fixing it to the two sleepers involved (G). Now take the curved frog-rail and fix it. When soldered to the sleepers, solder the inside of the frog, well filled with solder. The other pair of frog-rails are set in as shown in (H), using the short gauge block to fix the rails, and keeping the laths in place. Now fill in with solder the other frog.

Then remove the work from the laths and file off the waste solder on the frogs, till they are nice and smooth. Take the jig and fit in the crossover you have thus far made.

To do this, it may be necessary to shift the sleepers, or one or two of them, but this is all in the work. Then fill in with long sleepers the space between the two middle sleepers already fitted.

Also use long sleepers for any part where the shorter ones will not give enough projection at the ends. Use the shorter sleepers for the remaining spaces, but be very careful to get everything strictly to gauge. This part of the work is shown in (C).

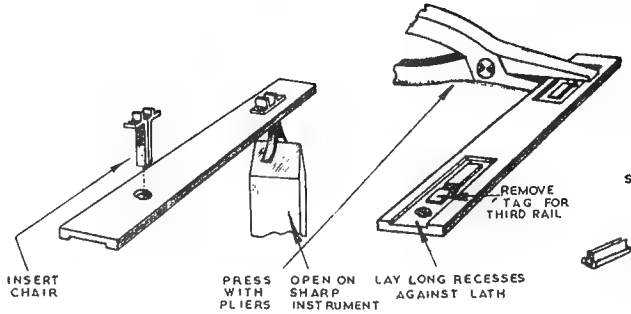
The switch-rails are shaped as required, and to fix them use for the switch-rails themselves two bits of $\frac{1}{16}$ in. thick brass strip, on their edges. One should be dead straight, the other slightly curved, each about 4 ins. long. With these you can true up the curve. Solder the blades only along the check-rails. Then fit a long sleeper under the rails to form the switch-rod.

When done, the solder on the inside of the rails should be filed off, using a rat-tail file, very small. For the check-rails opposite the switch-rail checks do not use $\frac{1}{16}$-in. strip, but use pieces of loose 00-Gauge rail instead. This will give a varied width to the checks and will enable you to run any of the standard wheels over your points. The points, when finished, are cleaned off as the straights.

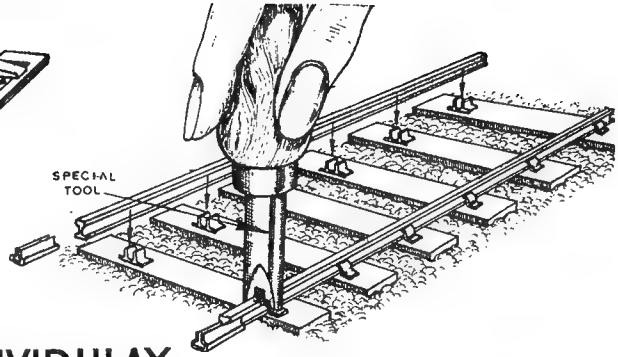
The greatest care of all must be taken at the frog-ends of the switch-rails. These must be exactly symmetrical and sweetly shaped, or the wheels will foul. But after a little patient practice the work grows quite easy and natural.

So much for the all-metal type of track, in which the two running rails are bonded together so as to carry one element of the current, the other element being supplied through an insulated third rail. The majority of workers will, however, no doubt prefer to instal track on the insulated sleeper principle, even if only with a view to the possibility of a later changeover to two-rail. Of such insulated track there are various kinds for which sets of commercial parts are supplied by various manufacturers, and each of which has its advantages. An excellent made-up track is sold by G. E. Mellor which provides faultless running and easy insulation at crossings. Several forms of chaired track are obtainable—the Hambling, the Walker and the Peco. Hambling track is of two types, A and B, the former being provided with slip-on chairs, the latter consisting of sleepers ready provided with metal eyes on to which the rail is soldered by using a jig as already described. Of the two types the second is by far the more speedily built up and has a very satisfactory appearance, the sleepers being of only medium thickness. Walker's (or Romford) track has punched sleepers into which metal chairs are clipped. Peco track is also produced in two forms known respectively as the "underlay" and the "individulay" types. The former—and both varieties are sold in kit form only—is provided with an embossed and coloured underlay strip representing the sleepers and ballast, and forming a very convincing and satisfactory imitation. The other type is intended for use in the usual way with granulated ballast, as in the instance of all the component track outfits. The one drawback attaching to all the existing track schemes on the commercial market sold in parts is the amount of time and labour involved in building them up.

In the writer's opinion, the ideal commercial track would consist of precision-punched, thinnish fibre sleepers, each provided with one hole for each rail, some being provided with fixing holes in addition, along with sharp-pointed, square-headed tacks about $\frac{3}{16}$ in. in length. Optionally, a

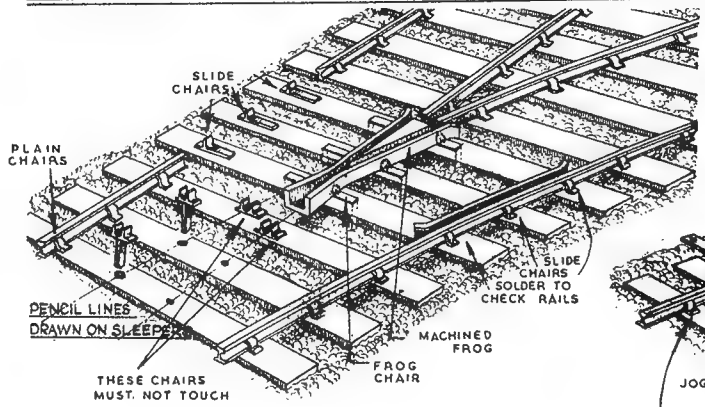


CHAIRING THE SLEEPERS

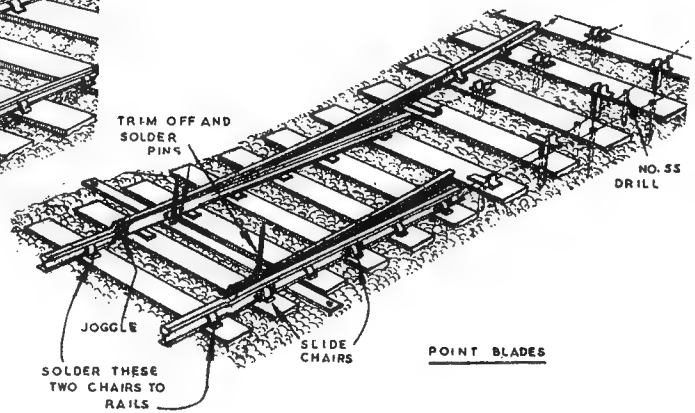


CLINCHING THE CHAIRS

TRACK & POINTS IN PECO INDIVIDULAY



LAYING A POINT



POINT BLADES

FIG. 3

shaped roadbed strip might also be provided, say, $\frac{1}{8}$ in. thick by slightly under 2 ins. wide, with chamfered edges. The sleepers could be glued in place, the tacks driven in, and the rail soldered on with great expedition. The square shape of the tack-heads would provide a perfect base for an imitation chair. Soldering would all be done outside the rails, and the occasional jolting of wheel flanges on chair-heads thus avoided. This form of track would be built up exactly in the manner described for all-metal track. It could be ballasted while the glue is wet and before the rail is fixed.

A very useful additional feature in connection with Peco outfits is the cast frog, the use of which entirely dispenses with the trouble and time involved in aligning the crossing of a point.

The ingenious worker may find it advantageous to combine the use of certain small-gauge track equipment as sold by the different manufacturers. But this is a matter for his own judgment.

For 0-Gauge the track-component market is equally rich and varied. But I have been interested to observe that reputed modellers almost invariably have their own individual methods of track construction,

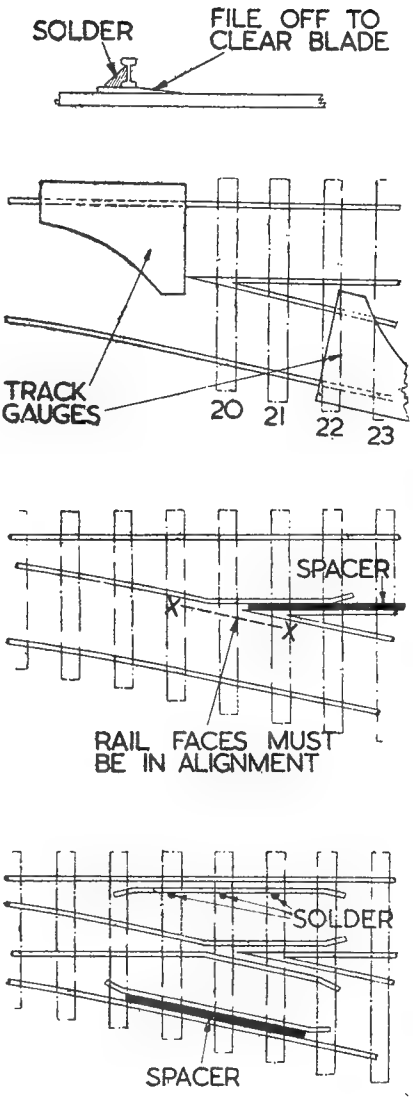


FIG. 3a. POINTS WITH HAMBLING SYSTEM

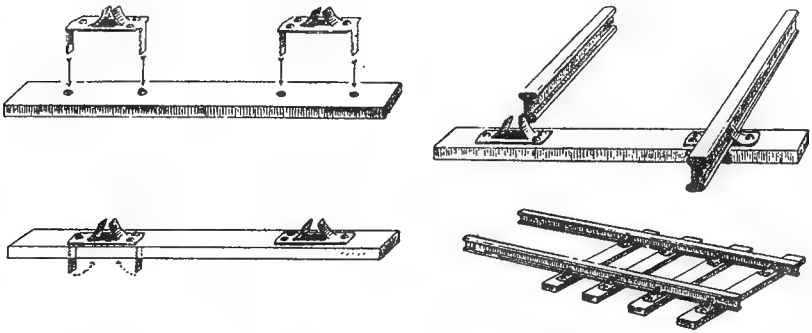


FIG. 3b. WALKER'S CHAIRED TRACK

FIG. 4. 0-GAUGE TRACK PARTS (*Bassert-Lowke*)

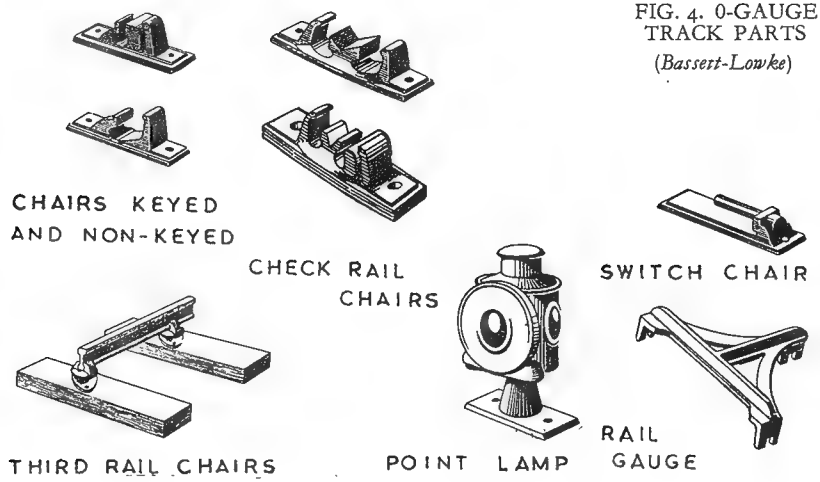
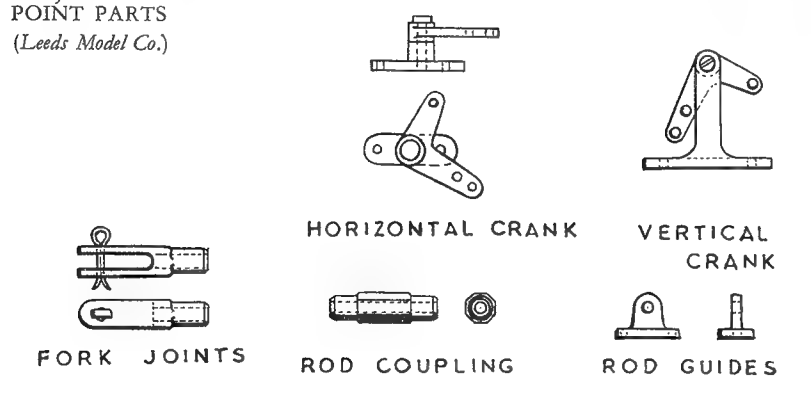


FIG. 5. 0-GAUGE POINT PARTS (*Leeds Model Co.*)



using kit items from various sources. Possibly this custom has derived from the fact that the requisite parts are often in short supply. Bassett-Lowke, Mills, Leeds, Bonds and others all provide this track material when available, and it comprises chairs, rail, keys, spikes and sleepers, as well as special chairs for point construction. Anything other than a chaired track is out of the question in 0-Gauge, and in my own opinion an ideal method is to use the excellent fine-scale precision rail as supplied by Rocket Precision, together with correct chairs and sleepers of cardboard on a wooden roadbed. Dennison's ½-in. passepartout card strip was ideal for sleepers when obtainable, as it was precision cut and uniform in surface. Glue the sleepers in place on the roadbed—which for all track must be absolutely level and even—and paint sleepers and bed to the desired shade of dark brown, with flat-drying paint. Coat the whole of the surface, with the exception of the sleeper tops, with hot glue and spread the whole with fine gravel dust or ballast which has previously been mixed with soot and water. Some workers prefer to mix the chips and soot with hot glue first, and this secures much greater adhesiveness. The chairs are next fitted (minus keys) to the rail, and (the ballast being set) attached by the use of a straight-edge to the sleepers—several lengths of single rail first. This is then keyed up and the second rail similarly laid with a gauge.

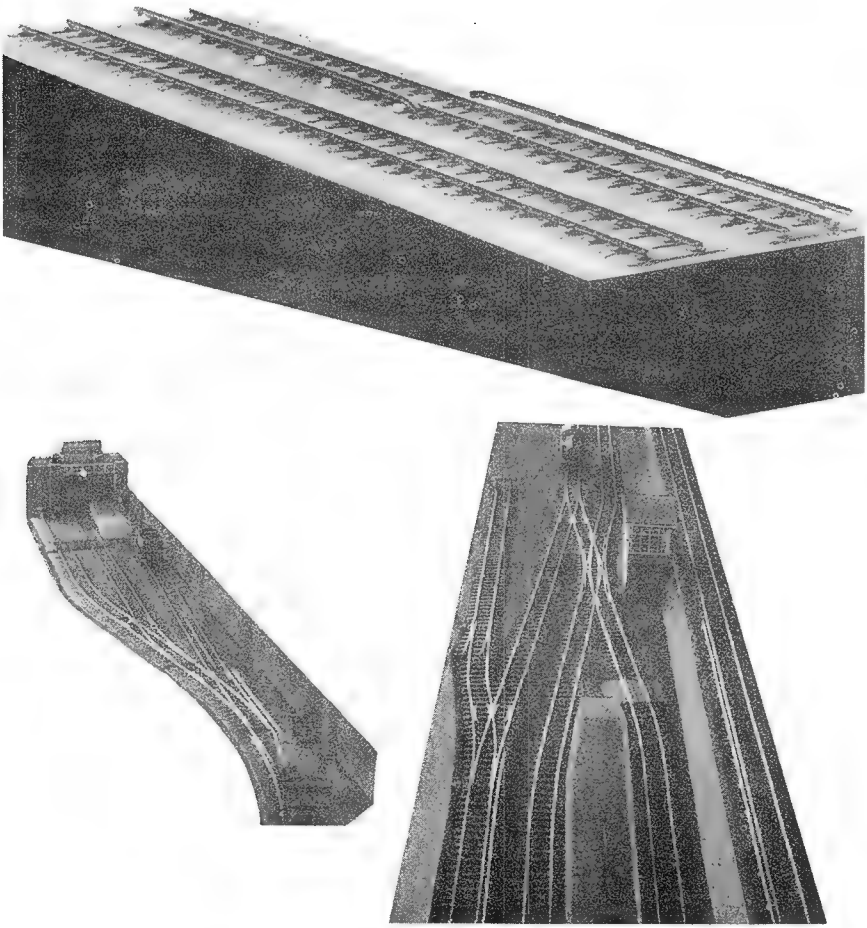
An excellent idea is that of using the very best scale track on all the visible parts of the layout, and having recourse to cheaper forms of track for any parts of the railway which are either invisible or remote. A considerable saving can thus be secured; and so long as the cheaper track is accurate it will be just as satisfactory. The same rule applies, of course, to sleeper-spacing. While visible parts of the system should have sleepers to scale spacing, track in tunnels, beneath baseboards and in concealed parts need have sleepers at three times scale spacing only, or even no sleepers at all.

There are various other methods of representing ballast besides that of employing any granulated material laid on. The ballast papers sold by Modelcraft give an excellent appearance, especially with the thinner type of sleeper, and should certainly be used for all background tracks in the smaller standards, for at a slight distance the paper is quite indistinguishable from actual ballasting. A well-known worker has used dyed felt baize, which very quickly lifts itself up between the sleepers and takes a most realistic form. Rubberised duck is also most excellent in the same way, and tends also to silent running. It can be painted any desired colour.

Buffer-stops have been so often described that little need be said about them here, beyond the statement that excellent kits comprising

correctly shaped rail brackets and buffing beams are on the commercial market in all scales.

Mechanical point operation in 0-Gauge is carried out with much greater fidelity to real practice than in the smaller gauges, where the pull lost by crank-play is a greater problem. Various components retailed by Bassett-Lowke and Leeds are illustrated. So far as the small standards are concerned, the worker will find a full description of approved methods in the third handbook in this series entitled *Three-Rail Control.*



PECO TRACK

BANKS AND CUTTINGS

IN every instance where one track surmounts or passes beneath another there will be the need of either an embankment or a cutting. The structure of these will depend upon the nature of the earthwork represented and upon the lateral space at disposal on the layout at this locality. Both cuttings and banks are also requisite at other points than where tracks overpass each other—as, for example, where there is occasion to cut through a hill or to make a "fill" across a valley. Both cuttings and banks may be entirely of earth or rock, or of masonry or brickwork, but where mere earth is involved in the structure there will require to be adequate space. The slope of an earth cutting must conform to certain mathematical proportions, and there must be ample room for the required slope if earth is the material, though modification in this required space is possible by combining the earth bank or cutting with a partial structure in masonry or brick. Thus, in Fig. 6 we have diagrams indicative of various arrangements. A double-track soil cutting or bank will require in 00-Gauge no less than 12 in. of lateral space, and for single track 10½ in. This is a formidable matter sometimes, so that it may be advantageous to decrease the space and simulate the walls of the structure with rock. A double-track rock cutting can be arranged within 6 in., and for single track only 4 in. will be necessary.

By introducing walls within a cutting or as part of an embankment there will be a proportionate saving. But for the great majority of locations on a layout the only feasible procedure will be to arrange for a genuinely walled structure as such. Sometimes the walls of these are straight, sometimes slightly sloped as the diagram shows. A useful and picturesque arrangement is that of the rock cut and fill with wall, where a single- or double-track alone is the problem.

In constructing these features, the earth slopes of a bank or cut may best be modelled by using a foundation of medical lint which has been sized and covering this with earth dust sprinkled over hot glue. Rocks may consist of actual pieces of rock or stone pressed into some plastic material such as Pyruma, or by covering chocks of wood, suitably placed and fixed, with painted medical lint. Retaining walls are best built of thin

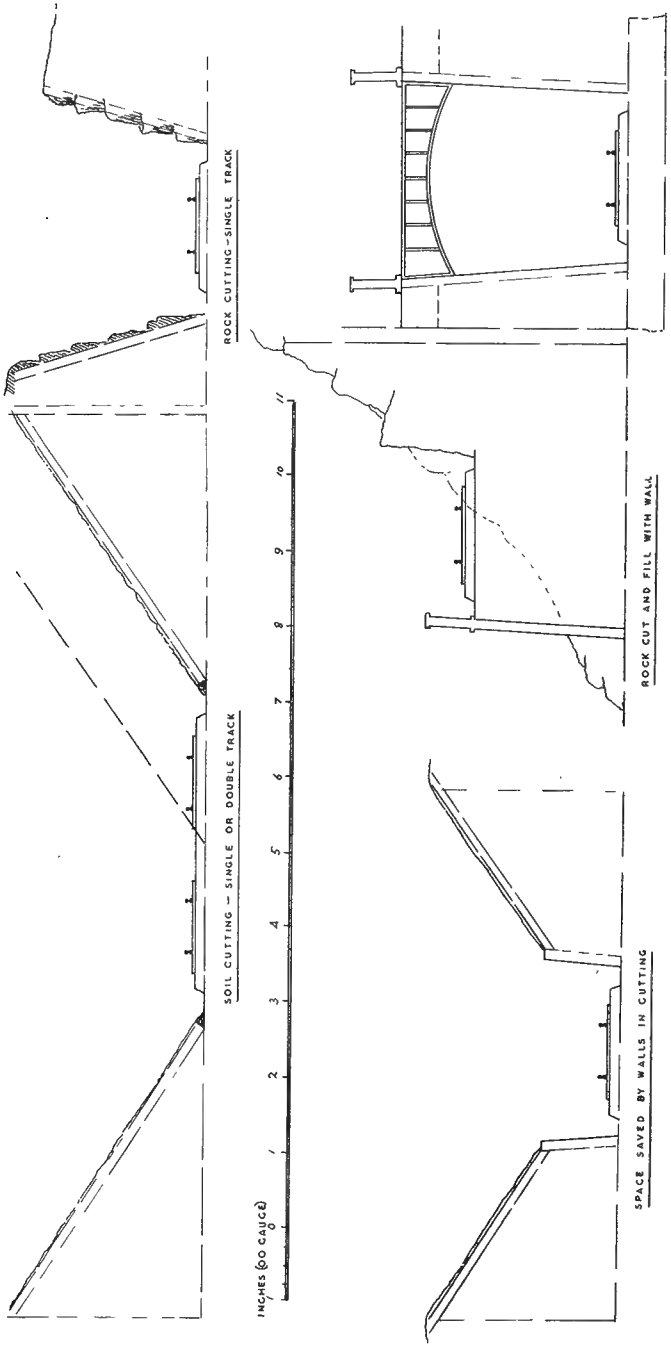

ROCK CUTTING-SINGLE TRACK
SOIL CUTTING – SINGLE OR DOUBLE TRACK
INCHES (OO GAUGE)
0 1 2 3 4 5 6 7 8 9 10 11
ROCK CUT AND FILL WITH WALL
SPACE SAVED BY WALLS IN CUTTING

FIG. 6 CUTTINGS

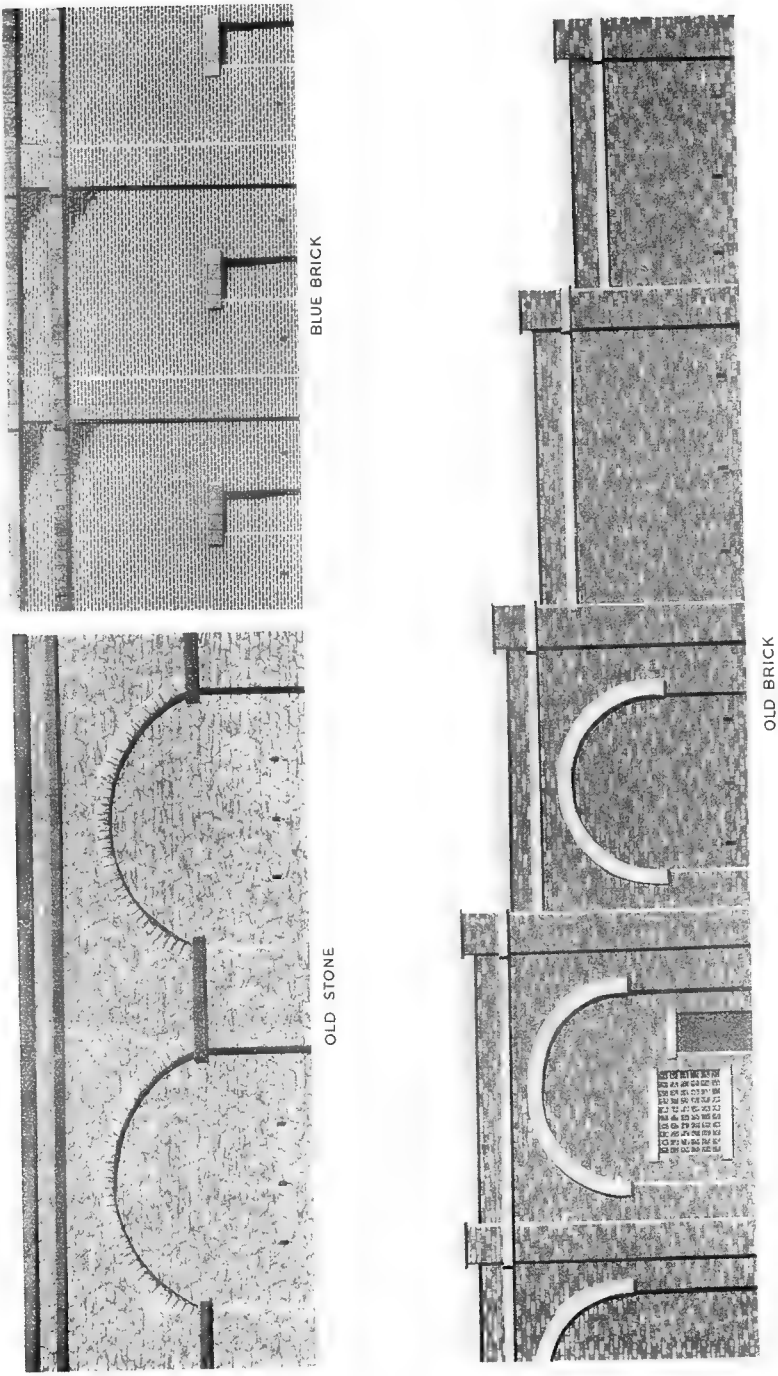


FIG. 7. BUILDING PAPERS ON WALLS

wood which can still be had in reasonably narrow widths. There are various methods of facing up such walls. For 0-Gauge there are embossed sheets of brickwood, and much can also be done by the artistic with paint and brush. For the smaller scales there are large ranges of brick and stone papers to be had, though these require to be treated judiciously. I give several reproductions to illustrate the effectiveness of Modelcraft and other papers when thus employed. It is desirable to introduce arches where possible, as this procedure serves to break up the monotonous expanse of masonry. Weep holes also add to the appearance, especially if carefully finished off to suggest the marks left by the constant trickle of water.

FIG. 7a. Mr. NORRIS'S CONCRETE OVERBRIDGE

BRIDGES AND VIADUCTS

IT is important to bear in mind in adopting a bridge design that the type of bridge would be determined by such factors as the absence or presence of river traffic, the atmospheric and weather conditions obtaining at the location, the natural comparative heights of the river tide (if any river) and of the surrounding land as a means of approach at a given level. The modeller should not fall into the error of imagining that any fancied type of structure will be permissible anywhere. Furthermore, for opening spans, it should be remembered that lattice and truss girders are preferable owing to their low wind resistance. These determinants being borne in mind, then, the various types of bridges might thus be classified for our purpose :—

Through :
- Girder : Box
  Plate (bowstring, plain)
  Truss (bowstring, pony, plain, etc.)
  Lattice (bowstring, plain, etc.)
- Cantilever

Deck :
- Box girder
- Plate girder
- Lattice girder

Flying Girder :
- Box
- Plate
- Lattice

Opening :
- Lift : Pivoted, rolling, sliding
- Swing : Centre or end axis

Arch :
- Stone or brick
- Concrete
- Steel

Viaducts :

Through : Steel, timber, lattice, plate, etc.
Trestle : Steel, timber
Deck : Lattice, plate, box
Masonry arch
Brick arch

Suspension

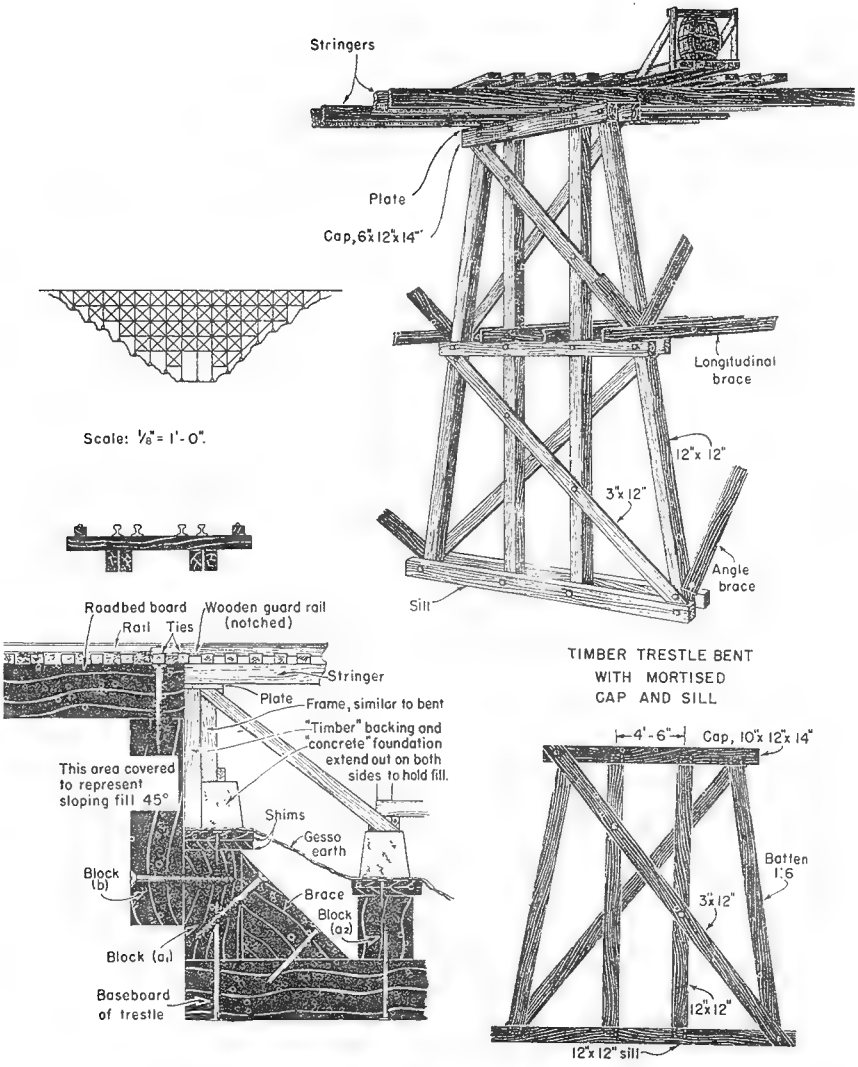
This list is by no means exhaustive, and numerous variations and combinations are correct. A truss bridge is one in which the main members are formed of girders at relative tension and compression, these being built into the form of a truss. A box girder bridge has girders formed on the box principle, each girder having four sides and being hollow inside. A cantilever bridge has an integral central span resting on the free ends of outer spans which are balanced or anchored at their extremities. A through bridge is one on which the traffic passes between the girder or other structure ; a deck bridge carries the traffic along the top of the structure. Over-bridges are those which carry a highway over a railway ; under-bridges carry the railway over the highway. Occupation bridges are built for the convenience or to preserve the rights of properties intersected by the railway.

There are rigid designing rules which govern the permissible lengths of various types of span, highway clearances and general planning of bridges, and the worker will be wise if he obtains the guidance of a standard work upon the subject before finally setting out on any construction. An excellent scheme is to submit the given design to a civil engineer for his criticism.

With regard to viaducts, it goes without saying that the use of timber on any kind of modern layout would be excluded, though there are still in all countries remaining examples of timber viaducts on systems with any extensive history. The timber trestle is a most attractive item to model and to contemplate ; but where trestle viaducts are built today they are built in steel.

One of the unfortunate accompaniments of modelling is the fact that the necessarily sharp curves on a layout constantly involve problems relating to the curvature of bridges or bridge tracks. The only types of curved construction possible are trestles and masonry-arch bridges ; apart from these, all other girders must be straight. On sharp curves this will involve either wide decks or short spans, though much can often be done by adopting spans placed at a skew, that is, either not in parallel, or else overlapping one another.

FIG. 8.



AMERICAN TIMBER TRESTLE

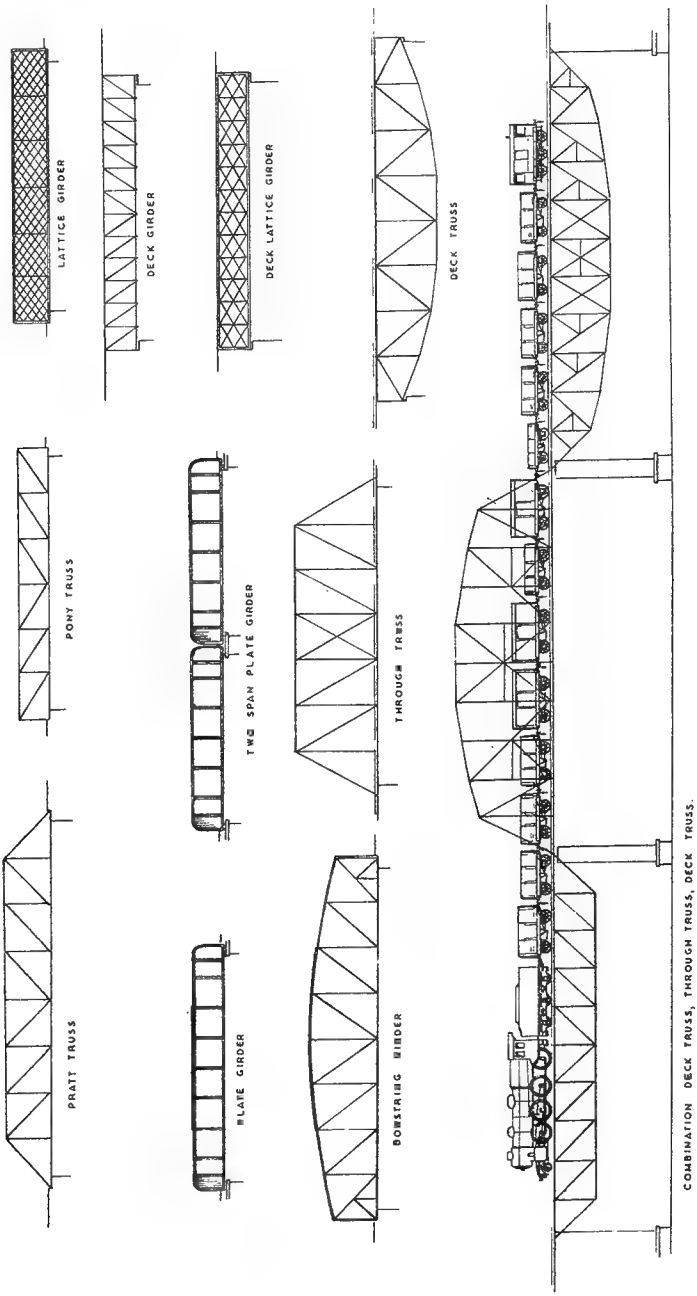


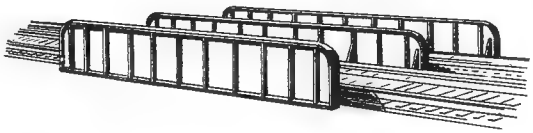
FIG. 9. BRIDGE TYPES

In Fig. 9 we have a number of diagrams showing bridge types, and in Fig. 8 a design for an old-style American timber trestle, the latter being adapted to a model. Excellent kits for these structures can be obtained in the United States to suit all scales. In building up the various open girder bridges it is not essential that metal shall be employed; some of the most perfect models have been built from stripwood or cardboard. The great thing to aim at is a robust and rigid construction. Lattices of the finer order can be worked up in metal, using coarse wire gauze or window-netting. Note also that combinations of the deck and through truss principles are correct.

Some attempt has been made in Fig. 10 to furnish an idea of the detail work on bridge girders. For the plate girder, an example with an intermediate span has been chosen. Note especially the side-webs and the cross-girders. The model should be built up in the manner indicated, the deck being afterwards added, whatever form it is to take. A more typical form of plate girder is shown on the lower right, where the girder is low and wide and where the planked deck (in one piece) is partly given. The best method of building up a number of identical open trusses (as at the upper right) is by having the work drawn out on a sheet of cardboard and pinned to the bench, the soldering or stripwood work being accurately arranged to the design. Each complete truss is then finished off by the addition of the cross-members. A number of splendid examples of bridge work in 0-Gauge as produced by Model Structures Co., of Santa Cruz, Cal., are shown in the photos. These models speak for themselves and are the last word in excellence. The "Starline" kits for smaller scales are also most reasonably priced and have all the boring and dimensioning carried out.

Arch bridges are shown in Fig. 11, and very picturesque models some of them make. These may be modelled in concrete, stone or brick, and are of course built of wood or stout cardboard, the latter being absolutely satisfactory, though small blocks of wood would be necessary, perhaps, for the arch bases. The amateur should beware of departing from the exactness of the designs especially at such points as the lower corners of the arches and at the piers where there are any. In Fig. 12 we have a more elaborate style of arch bridge having side arches spanning highways and being provided with wing-walls.

The subject of wing-walls and abutments is a very important one, and various types are shown in Figs. 11, 12 and 13. Straight abutment walls are most easily modelled, though wing-walls look very well. The small sketch in Fig. 11 may give an idea as to the correct placing of piers



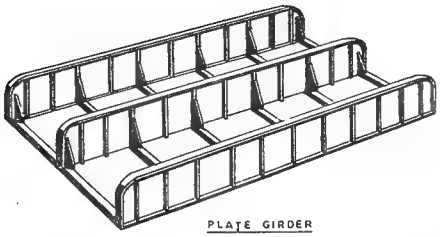
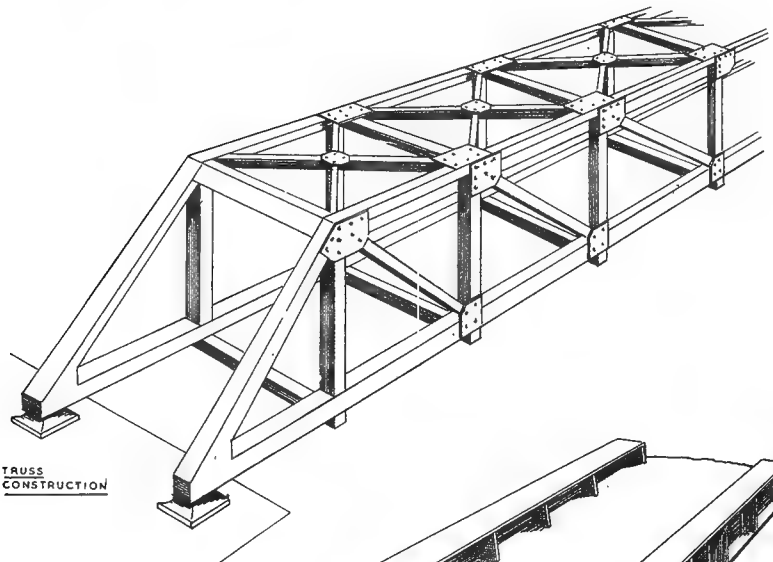


PLATE GIRDER

PLATE GIRDER
WITH INTERMEDIATE SPAN



TRUSS
CONSTRUCTION

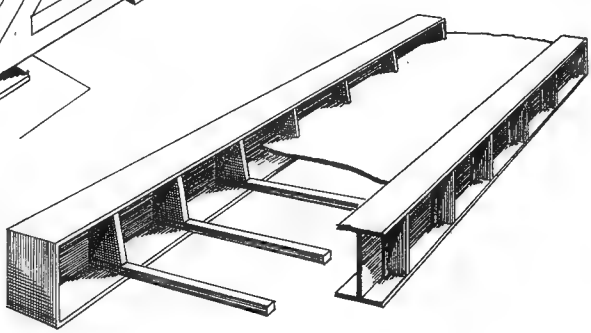
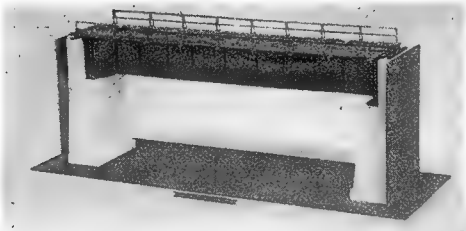
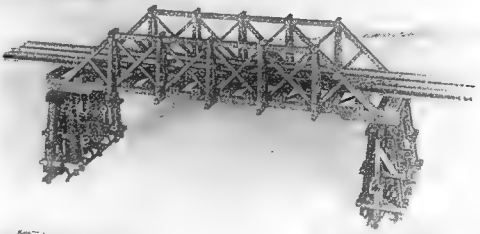


PLATE GIRDER CONSTRUCTION

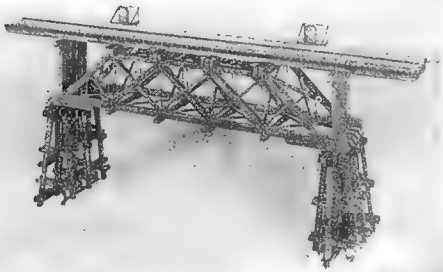
FIG. 10. BRIDGE DETAILS



80-FT DECK GIRDER

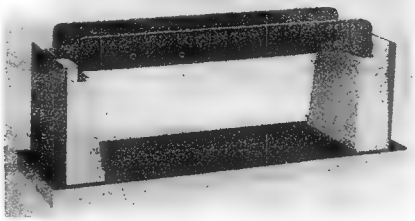


80-FT TRUSS

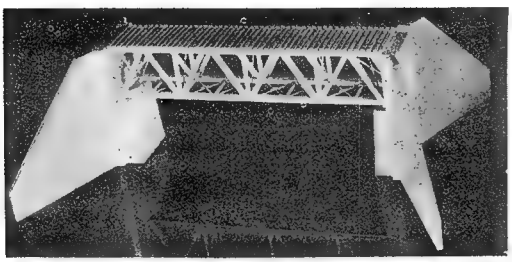


64-FT TIMBER DECK

80-FT THROUGH PLATE GIRDER



BRIDGES BY MODEL STRUCTURES CO.



DECK-TRUSS FROM STARLINE KIT

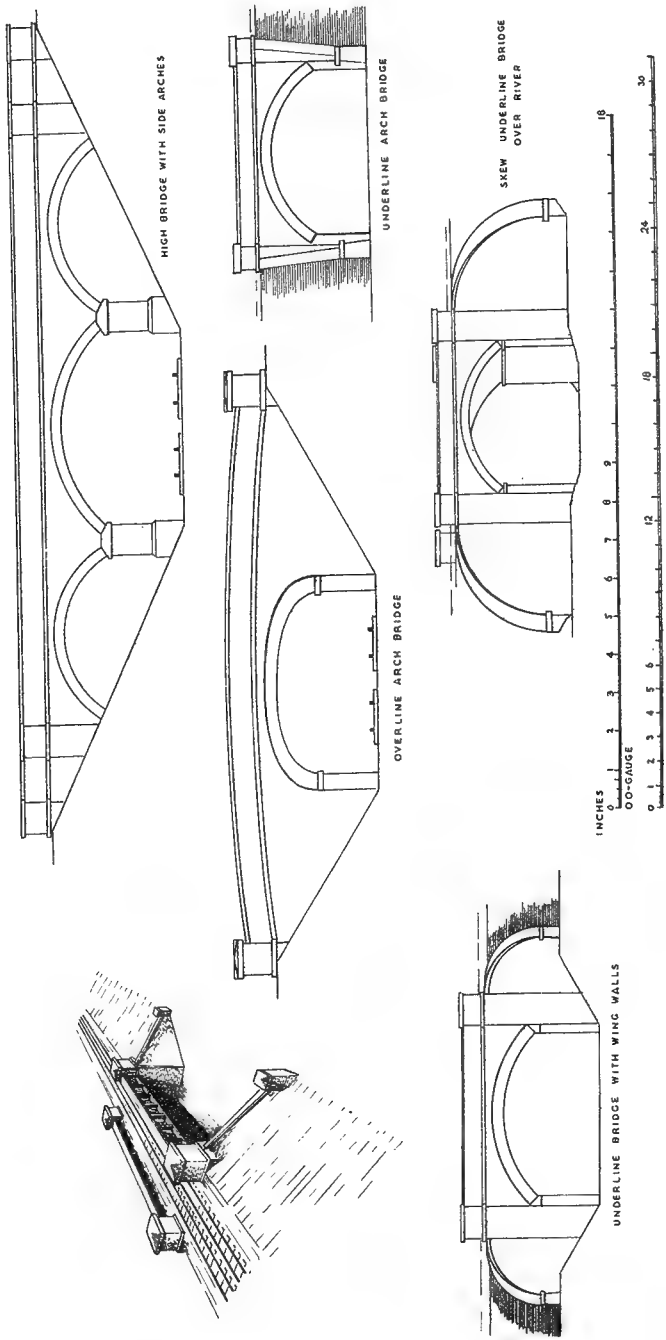


FIG. 11. ARCH BRIDGES

and the position of girders in relation to them. For deck-type viaducts two types of abutment are given in Fig. 13, the buttress type as often found in America and the plain stone arch type which is typically British. An effort has been made in Fig. 14 to show the effect of brick-paper as applied to a plate viaduct abutment, and for the smaller scales this method of finish can be recommended.

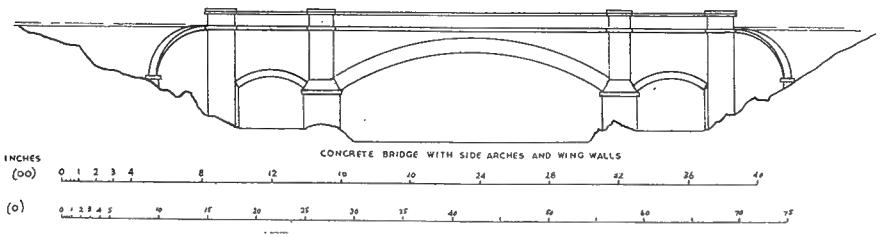


FIG. 12. CONCRETE ARCH

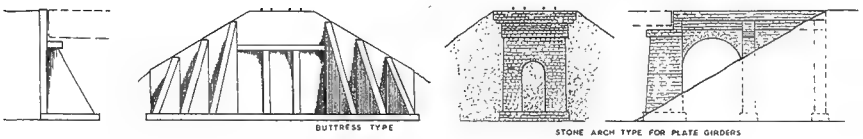


FIG. 13. ABUTMENTS

We pass on to the subject of opening bridges, which have a popular use on model layouts—that of spanning door-entrances or operating spaces which are crossed by railway tracks. The swing bridge—an example of which is taken from *The Model Railroader* (Figs. 16 and 17)—is of normal design, and can be operated in precisely the same way as a turntable, being counterbalanced and even in its movements.

Of the lifting type two examples are shown (Figs. 16, 18 and 19).

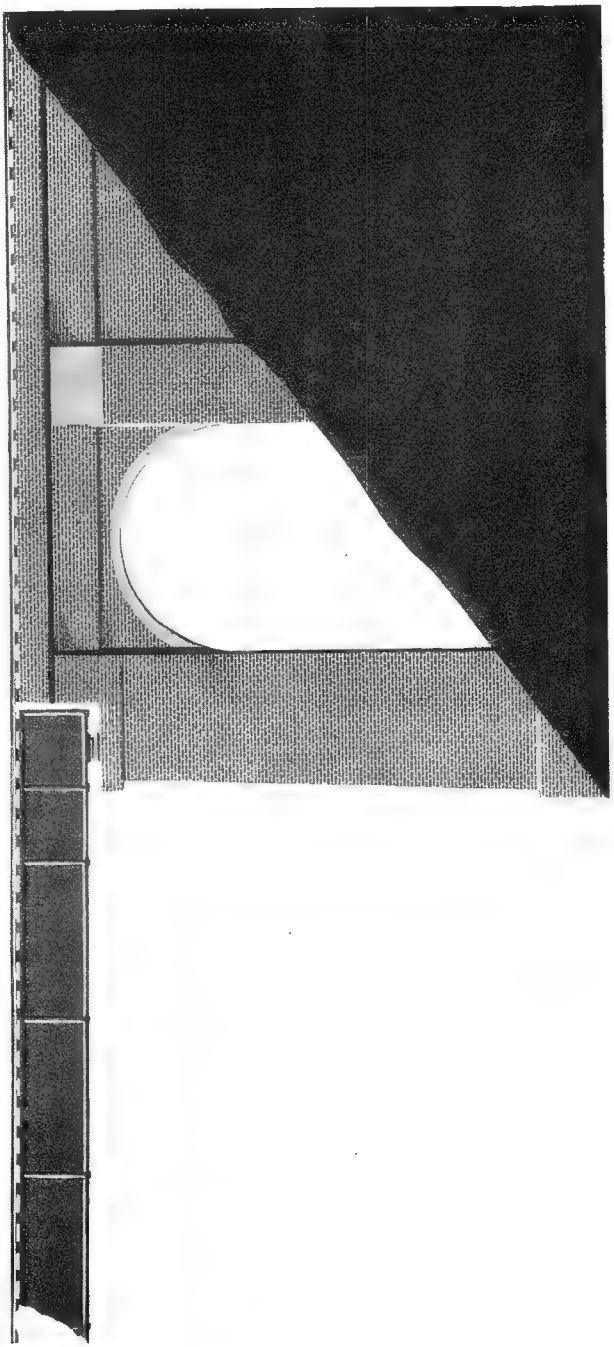
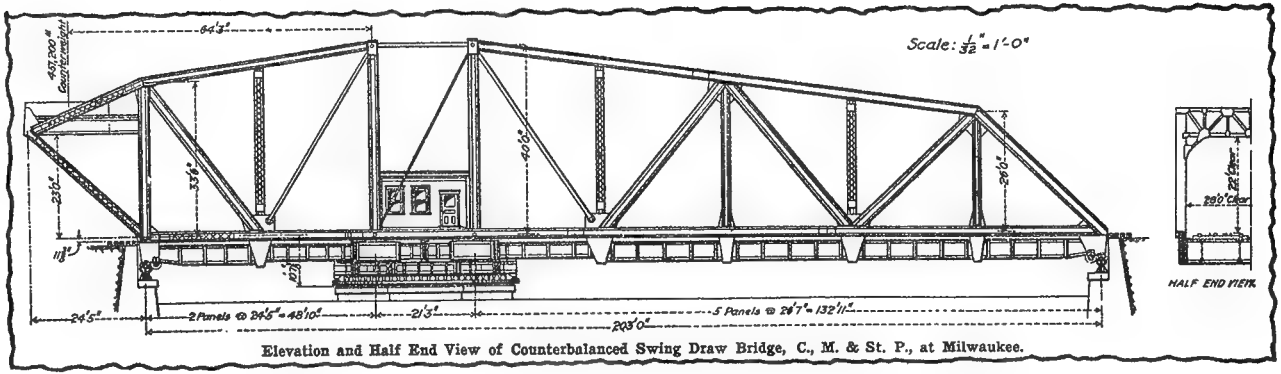


FIG. 14. ABUTMENT WITH BUILDING PAPER



Elevation and Half End View of Counterbalanced Swing Draw Bridge, C., M. & St. P., at Milwaukee.

FIG. 15

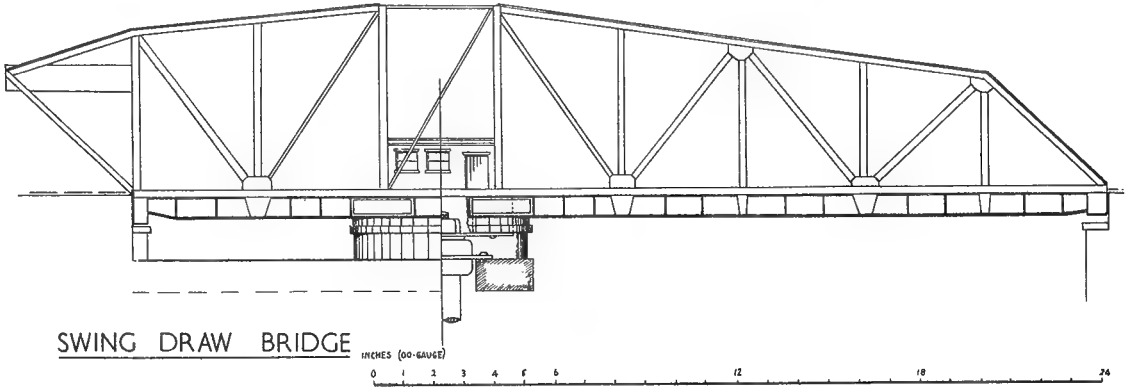


FIG. 17

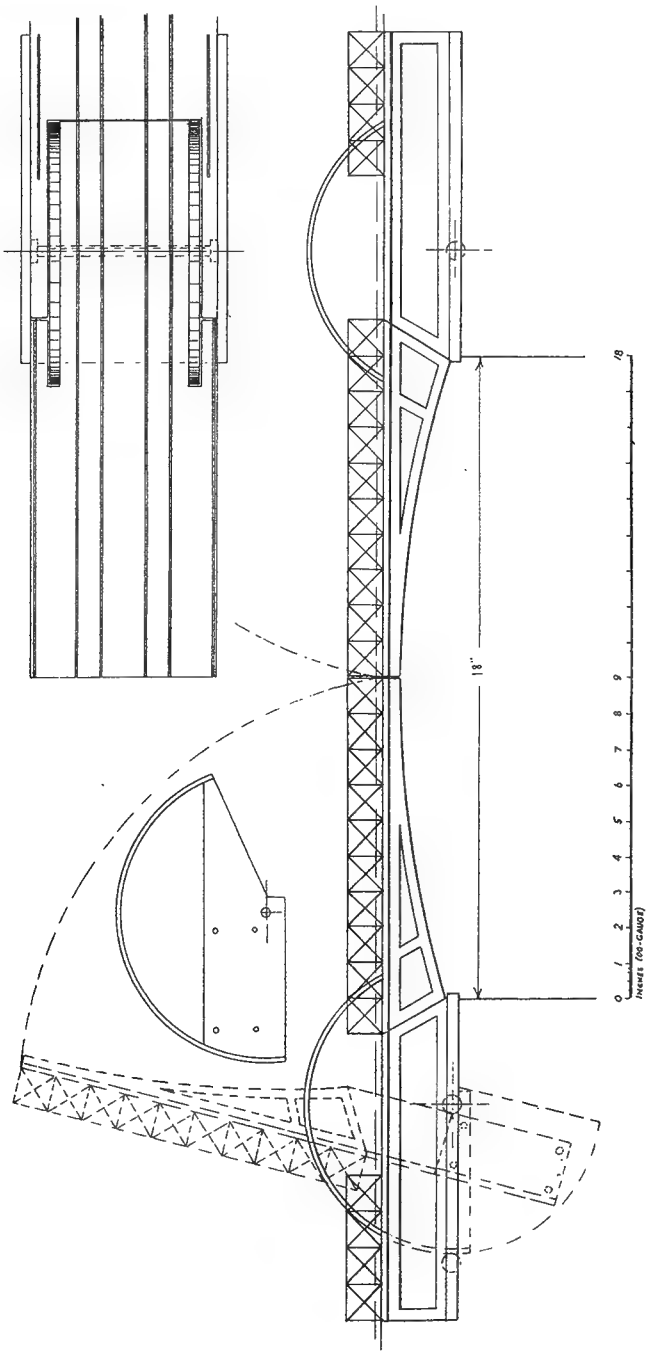


FIG. 16. DOUBLE SPAN PIVOTED LIFT BRIDGE

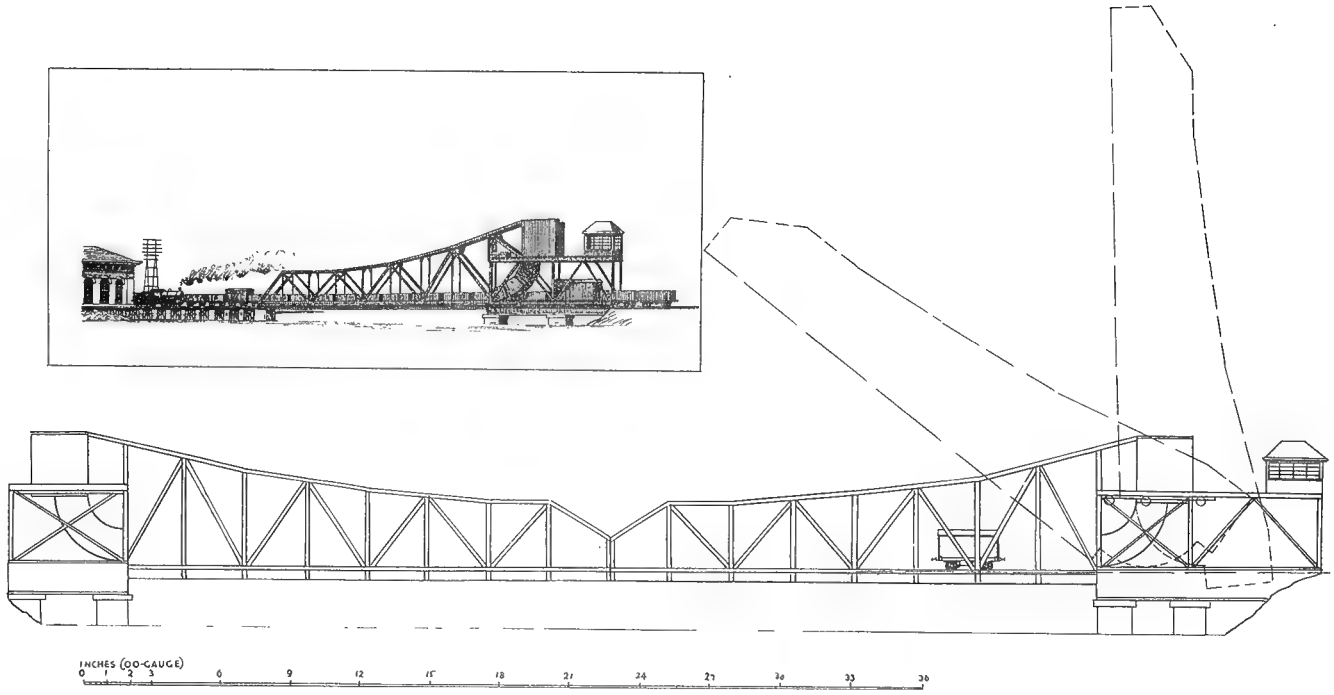


FIG. 18. SCHERTZER ROLLING LIFT BRIDGE

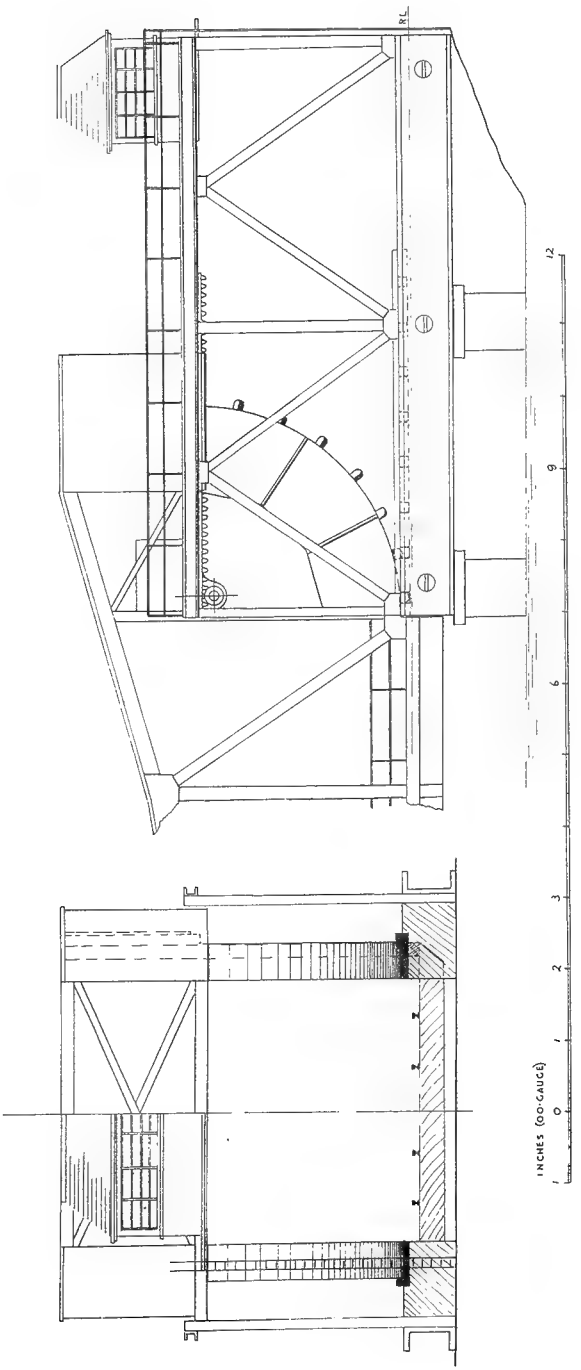


FIG. 19. ROLLING BRIDGE DETAILS

Fig. 16 depicts the double-span type and is a very attractive design operating on pivots, the drive being by means of a rack and pinion, should power driving be introduced. The width of the " channel " at the opening span should not be less than 18 ins. if spectators and operators are to get through it. The popular Schertzer lift bridge may take the form of the pivoted or the rolling type, the latter having been selected for the design in Figs. 18 and 19. The bridge may be either single- or double-leaf, and in the first figure the principle on which the bridge lifts and rolls back is indicated. The diagram shows three positions —closed, half open and fully open—and it will be observed that the structure rolls upon bearers shaped as the segments of a circle. The bearers are provided with pins which engage holes in the runway, the movement being determined by the pinion engaging the rack above. It will be seen that no matter what position the bridge is in, the level of this drive remains the same. The rack is attached to the side frames, which are immovable, the pinion being attached to the moving leaf. Counterbalances give the necessary ease of movement, so that any standard low-voltage motor with gearing will serve to operate the appliance. Generally speaking, it will be found that a single-leaf design will be sufficient. Note that the counterbalance weights must clear the cabin when the bridge is lifted. In Fig. 19 we have what I think is a very clear indication of the mechanism and its construction. For the runway engaging the pins, it is possible to use Mecanno strip, which is of correct size and ready punched to precision. For the pins it is advisable to use short lengths of Mecanno rod, which is made to fit the holes, though the short lengths will require to be filed round at the ends. Rack and pinion gear used to be obtainable at Bonds before the war. The fixed framework of the structure is built up from U-section brass channel of varying sizes which, at the base, is screwed to wooden blocks, fixed in turn to the baseboard.

The construction of the deck of a bridge is of an importance equal to that of the bridge itself, and may take the open steelwork form, or may be of timber or of ballast. Arch bridges are usually provided with a coarse filling and bottoming, covered with asphalt and finally faced with graded ballast. Timber decks are usually built flush with the tops of the tracks, the timbers being laid longitudinally as shown in Fig. 20 (D). B and C show a useful method to adopt on small bridges of the open-deck type, by using brass channel on to which the rails may be soldered. The arrangement gives a fair representation of the standard open-deck procedure of E. Guard-rails are usually fitted on the tracks of railway bridges, as in A, especially on all deck girders.

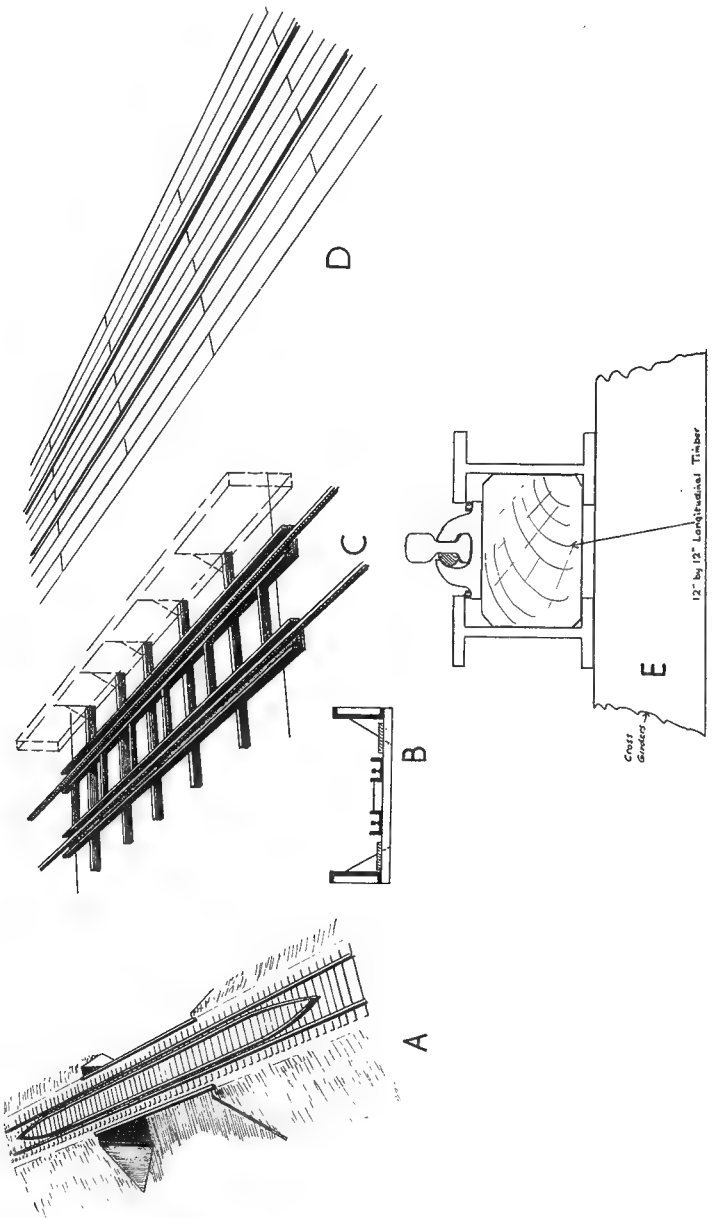
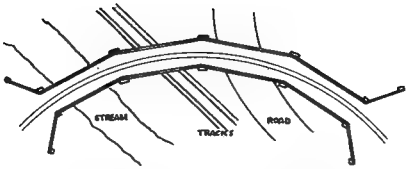
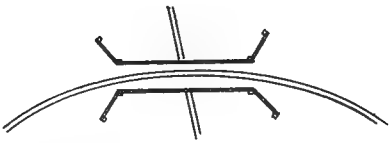


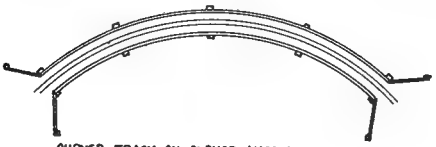
FIG. 20. TRACK ON BRIDGE DECKS



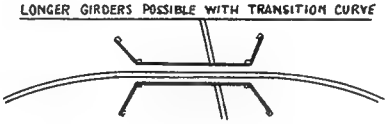
PLAN OF CURVE ON BRIDGE WITH STRAIGHT GIRDERS



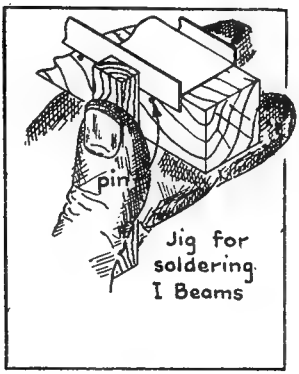
LONGER GIRDERS POSSIBLE WITH TRANSITION CURVE

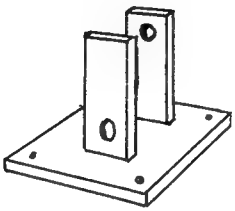


CURVED TRACK ON CURVED MASONRY ARCH



INTRODUCING SHORT STRAIGHT ON CURVE





GIRDER PEDESTALS

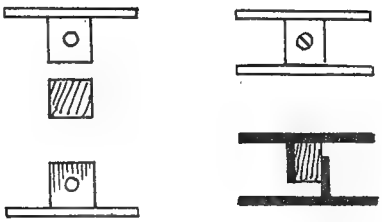


FIG. 24

Methods of building up buttresses to bridges have been discussed earlier in this series of handbooks. The worker is again reminded that a strong and solid substructure should be given to all such features. The amount of detail work put into bridges of all kinds depends to a large

extent upon the wish of the builder, but it must be said that the more of this there is, the better. One danger is to make bridges appear too spider-web-like and frail, though on the other hand they must not be too clumsy. The correct way is to work out on accurate lines the true scale requirements and to stick to these.

Much can be done towards improving the construction of models of bridges by the use of correct I-beams and T-beams. Sometimes these can be had in both brass and wood strip; but it is not a difficult matter to build up such beams from strips of stout tinplate, precision cut, such as were obtainable commercially before the war. The worker may even cut his own if he is proficient enough in the use of a file and shears to trim the strips evenly. Tinplate beams serve very well for small struts and hangers for which it would not be possible to obtain commercially prepared material. In the United States, also, it is the invariable practice to use pedestals for the ends of plate and other girders (Fig. 10, upper right), though in Britain their use is comparatively rare. Such pedestals are very easily made; a good method is to use a couple of 0-Gauge signal post bases for each pedestal, in the manner shown in Fig. 24, the castings (which are in white metal) being filed to shape and joined together by the insertion of a piece of stripwood.

SWING BRIDGE AT SUTTON (*Aerofilms*)

CULVERTS AND DRAINS

A culvert differs from a bridge in one fundamental respect apart from its size ; it has an intervening section of earth between the tracks and itself. The distinction will, at all events serve the modelmaker, though it must be said that there are bridges here and there throughout the country which have the same characteristic, but they are rare. There is a difference mainly, of course, in purpose ; a culvert has for its function the conveyance of water only. Designs for two representative types are given in Fig. 21, one of these being low, and without wing-walls, the other higher and built back into the embankment. These items make extremely effective models. A further interesting feature is the conduit (Fig. 22) which actually consists of a simple box girder supported by steel piers, serving to carry the water of a stream over the railway at a high level. For a model, the girder might simply consist of a solid strip of wood, suitably provided with imitations of joints and flanges.

Trackside drains are among those features which are almost invariably left out in modelling, like locking-bars and safety-points. But if included they would form a very convincing addition, and they happen to be very simple to model. Before laying the trackbed on the baseboard, insert strips of glass or celluloid about $\frac{1}{2}$ in. wide to represent the water, and pack if necessary the intermediate space with cardboard of the same thickness. Then lay your trackbed and side strips, which are duly ballasted and coated with earth, and the result will be like that shown in Fig. 21.

Pyruma is a modelling material which is most acceptable for use on such features as culverts, where low drainage banks require to be simulated. Building papers may also be used with effect provided that the correct ones are selected for the specific purpose.

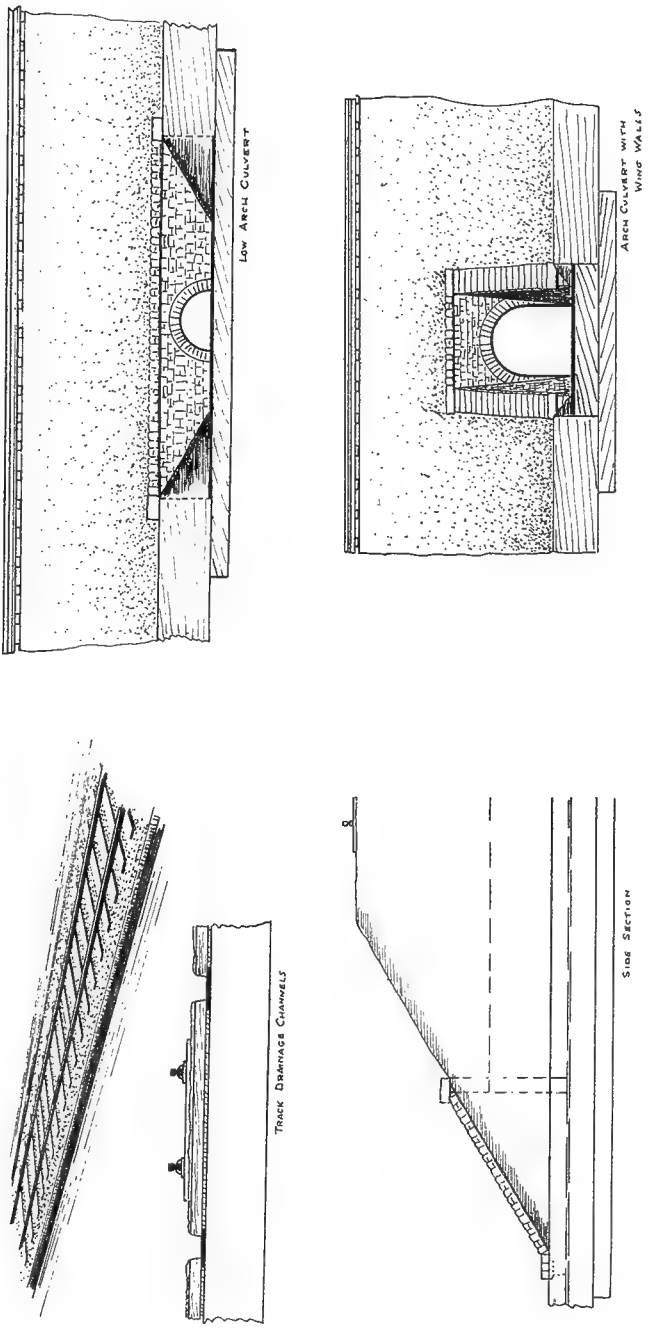


FIG. 21. CULVERTS AND DRAINS

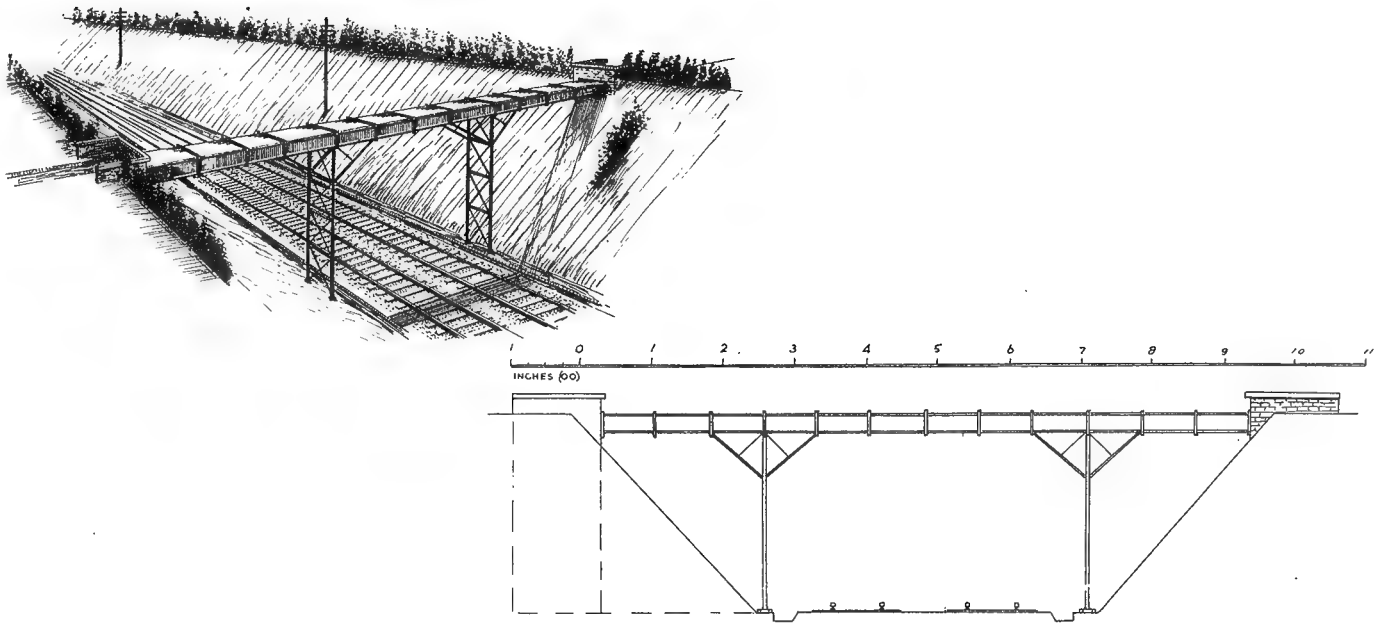


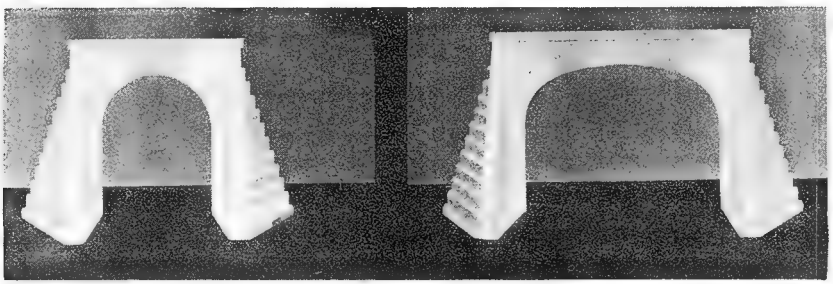
FIG. 22. BOX GIRDER CONDUIT

TUNNELS

SO much has been written on the subject of tunnels, that I propose simply to give examples (A, B, C, D in Fig. 23) of four representative kinds of construction. A is suitable where the simulated earthwork is rock; B has the wing-wall, while D has the straight walls with double piers and C has a plain wing. The types may be combined in the manner shown, or any of the four halves may be duplicated to form one complete entrance. A more important matter for the model-worker is that of joining up the tunnel face to the earthwork. In Fig. 25 some useful guidance is given. A concealed wooden framework serves as the foundation for the face, and the gradual declination of the "earth" towards the top parapet is accomplished by packing over the top of the framework balls of tightly crumpled paper or even pieces of rock. Over the whole of the "hill" and down behind the wing-walls there is then stretched a sheet of medical lint—plaster-of-paris lint, damped, is best—which is secured to the wing-walls by means of small triangles of wood or stout card (as in B), the wing-wall being screwed with small screws to the triangles. Where the open-top method of baseboard work is adopted, the framework is attached to the sides of the main track-board, as in C. The lint, when set, is painted for the occasion.

The use of building-papers on tunnel faces should not be overlooked, and some suggested treatments are shown in Fig. 26. The choice between wing-walls and a straight face depends for the modeller upon the width of the space at disposal for the track, and upon the type of earthwork to be represented.

TUNNEL PORTALS BY MODEL STRUCTURES CO.



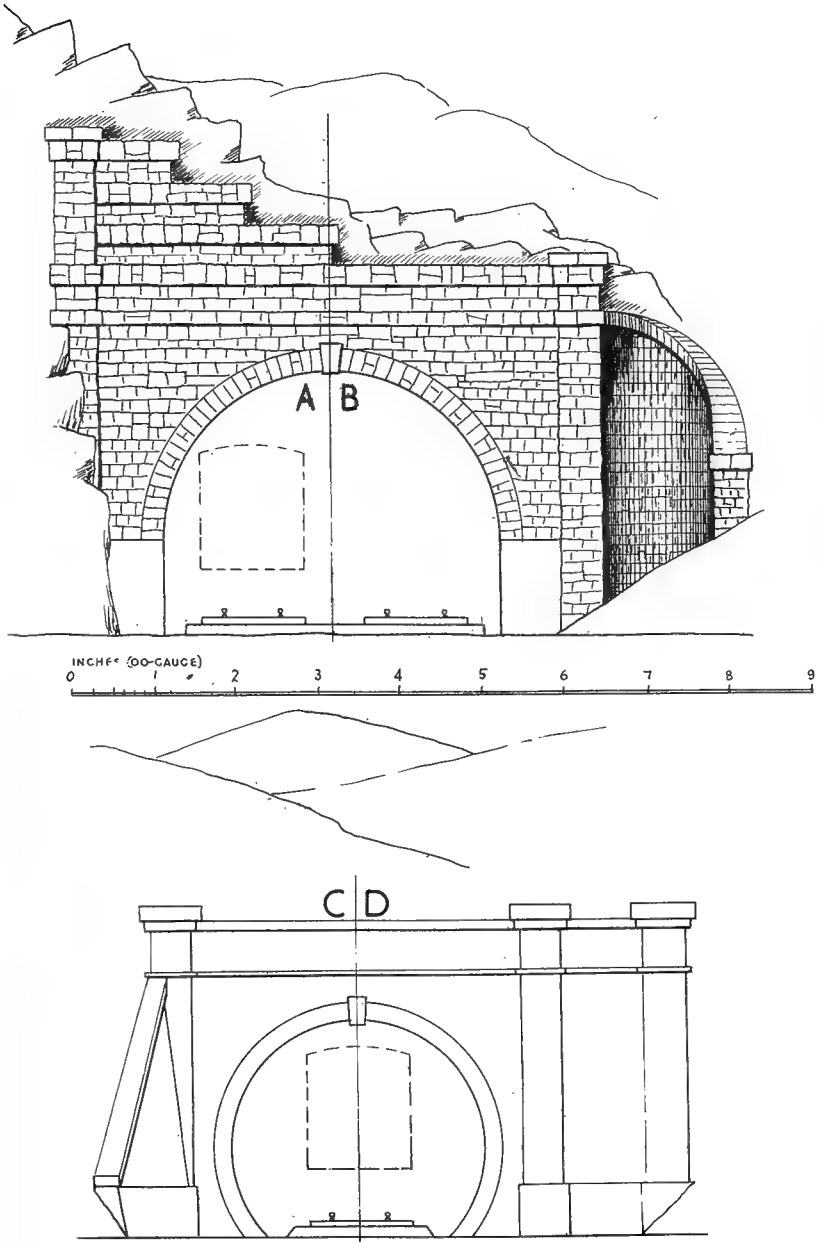


FIG. 23. TUNNEL FACES

FIG. 25. TUNNEL FRAMEWORK

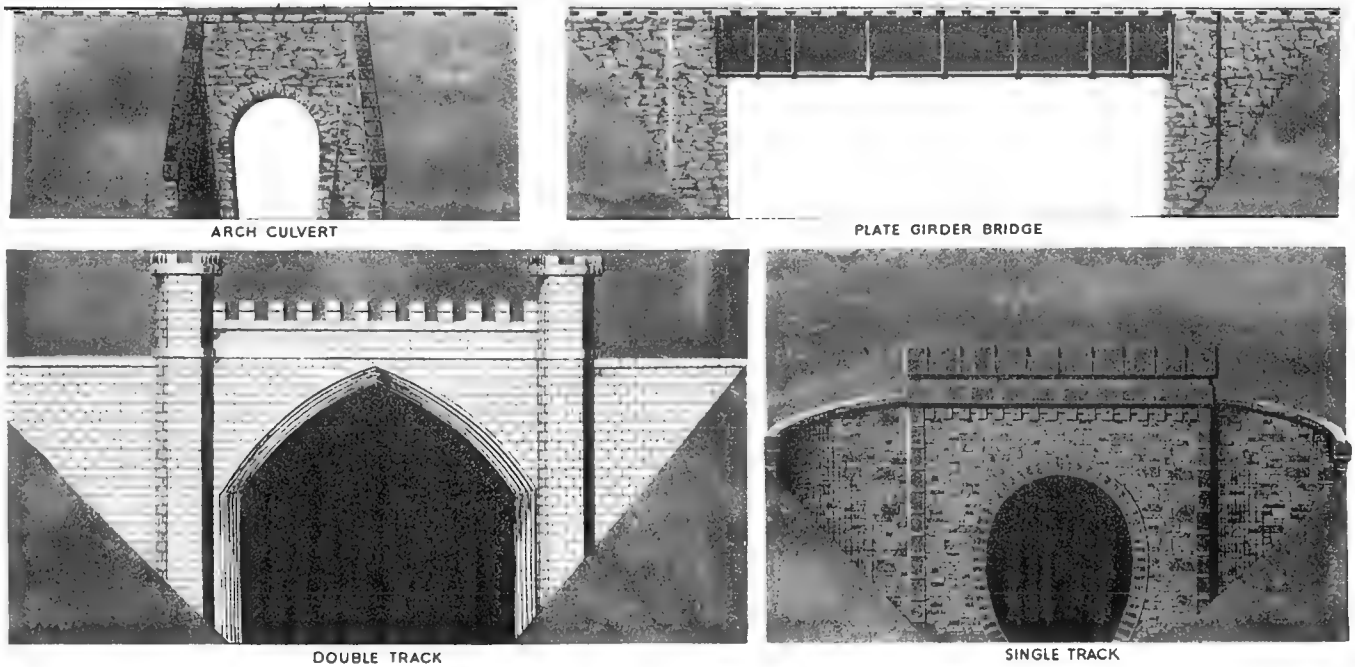
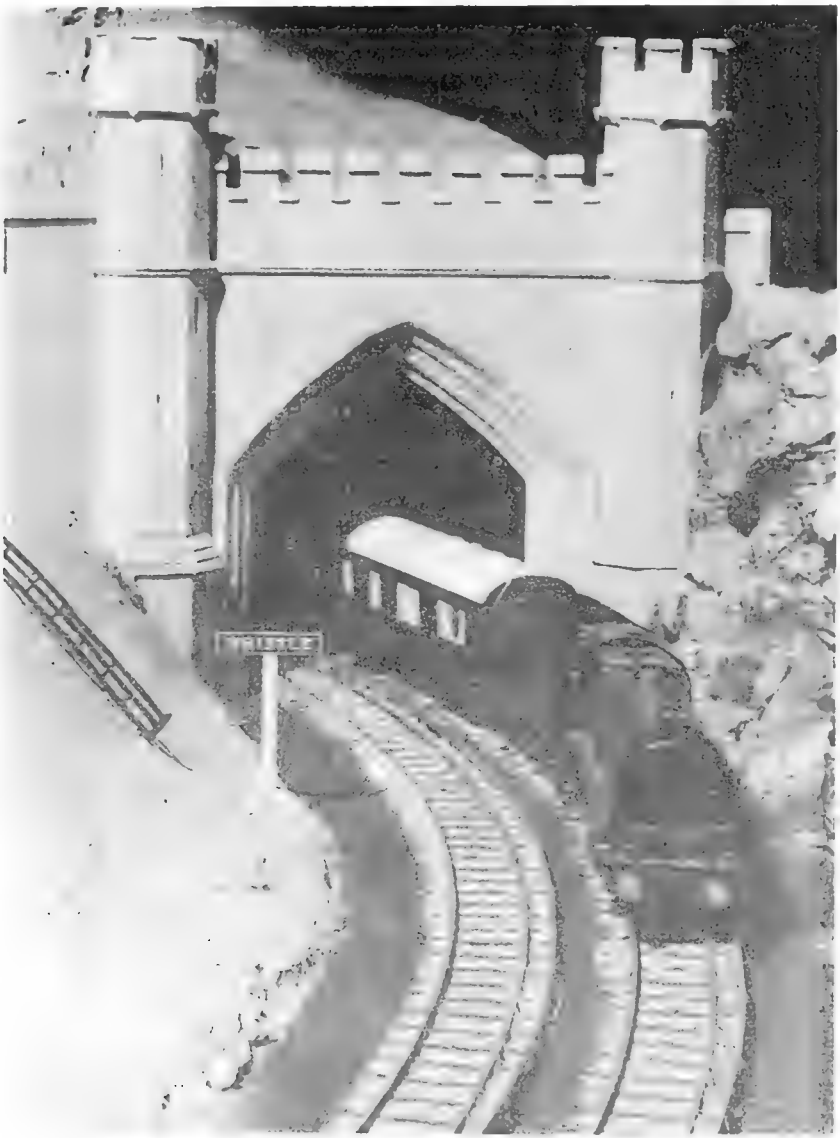


FIG. 26. BUILDING PAPERS ON TUNNELS, ETC.



0-GAUGE TUNNEL ENTRANCE BY Mr. KENYON (*Built in the Far East*)

FLYING- AND BURROWING-JUNCTIONS

A study of the uses of over- and under-track junctions is well worth while for the layout designer. Supposing that we desire to avoid the complications of a double-junction by carrying the crossover track above or below the main lines, and that we adopt the reasonable gradient of 1 in 40 as our principle of rise or fall. Methods of doing this are shown in Fig. 27 in the small diagrams at the top. First we have a plain flying-junction, in which R represents the rising tracks and L the level tracks. Here, the two main tracks are in the centre, and they are carried over the branch track, which passes by way of a bridge beneath the former. Having risen sufficiently to allow this underpass, the main tracks again run downwards to the normal level. This is known as a flying-junction; but in the burrowing-junction opposite, the procedure is, as it were, reversed. That is, the main tracks remain level (L) while the branch track burrows down between retaining walls and thus passes under. Further, seeing that the main lines remain level, it is not necessary to take out the down branch until at a point just ahead of the subway, and there is thus a saving in track by using the burrowing method.

It is obvious that a considerable length of baseboard is required for such a junction; actually for 00-Gauge (see A) it is 20 ft., whether flying or burrowing. But by combining the rise and fall, that is, by taking the central main lines downward (F equals falling) and by raising (R) the outer tracks, this length of required baseboard is halved. It may be said in parenthesis that a similar flying or burrowing method may be followed even where no actual junction of tracks is involved, as in the crossover scheme shown. Here the problem is to take two slow tracks running on the outer side of fast tracks and change them over so that the fast tracks are on the outside instead of the inside.

But there are other considerations that arise and which determine economy and convenience, besides the question of baseboard length. In A to H we see some of the remarkable range of possibilities that may be followed in planning these features. All of these eight schemes are flying-junctions, A being the one we first considered. B is the same form as the burrowing-junction discussed, but is a flying-junction. Note that

FLYING-JUNCTION NEAR CATERHAM (*Aerofilms*)

for half the distance there are only three tracks necessary. This is actually due to the fact that two adjacent tracks are kept at the normal level. In the diagrams, the rising track is in each instance marked with a cross. It is therefore a useful rule for economy that *one-eighth of the track is saved by*

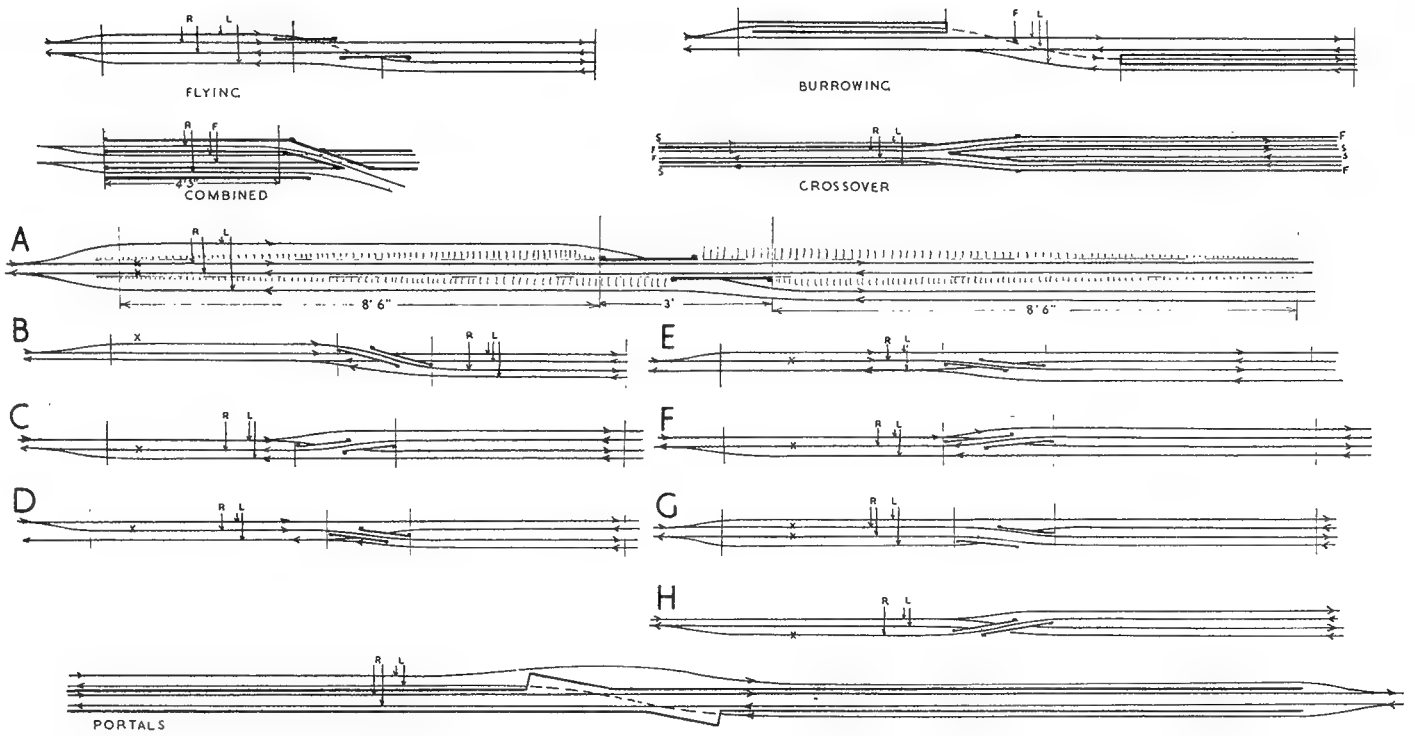


FIG. 27. FLYING- AND BURROWING-JUNCTIONS

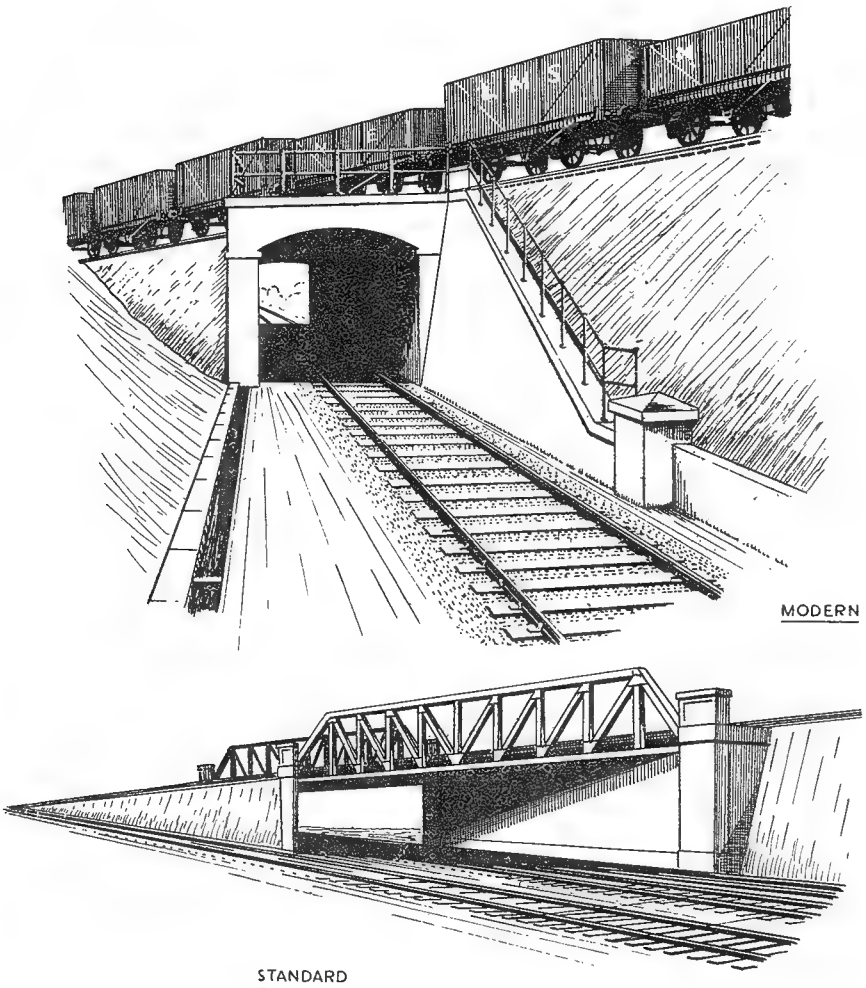


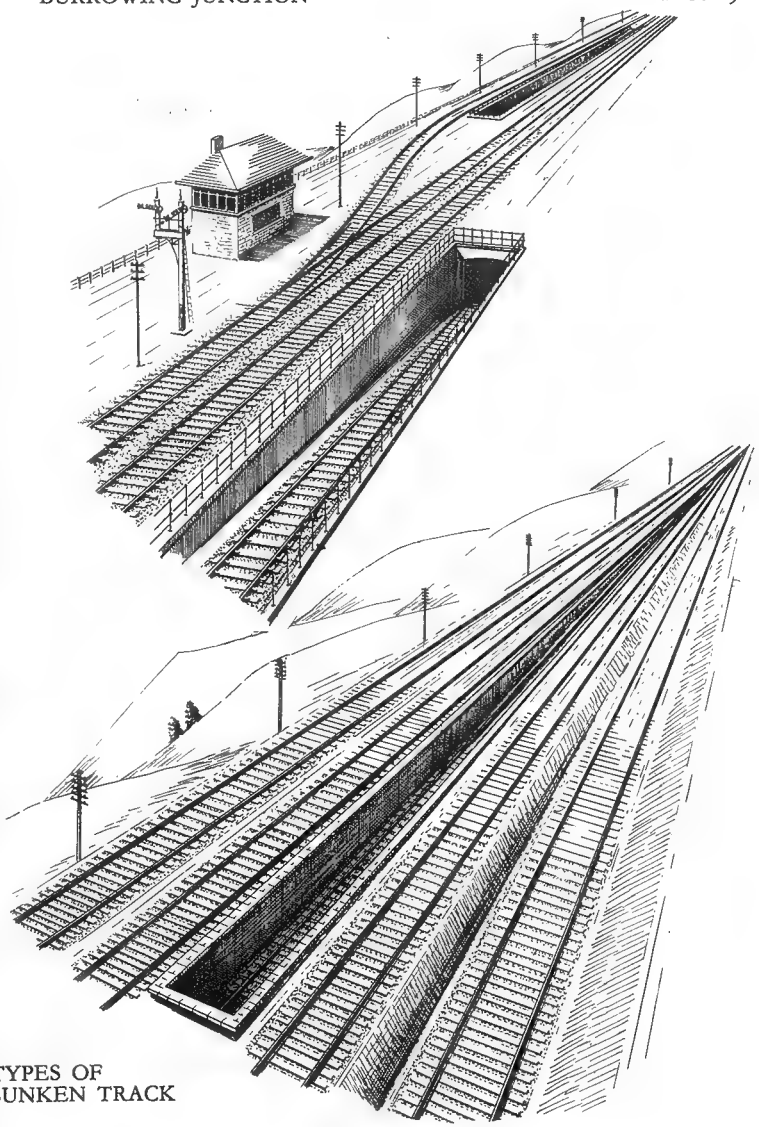
FIG. 28. BRIDGES AT FLY-OVERS

raising or depressing that track which will leave two adjacent tracks on the level.

In the lower diagram we have a plan of the modern method of arranging a concrete or masonry tunnel over which the flying track passes. A sketch of this feature is given in Fig. 28, the accompanying sketch showing the more standard and earlier type of bridge for the same purpose.

The construction of a burrowing-junction is sketched in Fig. 29,

BURROWING-JUNCTION FIG. 29



TYPES OF
SUNKEN TRACK

in order to give the amateur an idea of its general method and appearance. In this instance the depressed tracks run down between steep retaining walls ; but, as the accompanying sketch will show, such tracks may be sunk by means of ordinary cuttings if the space allows it.

TIMBERWORK AND STEELWORK

APART from bridges and similar structures, there are numerous occasions when the civil engineer has to provide steel- and timber-work for railway construction. A glance at Fig. 30 will reveal some examples, these embracing such items as roof principals, trusses, bents for trestles, and so forth. In A, we have a suggested scheme for either soldering up or building up, according to whether metal or stripwood is being used. As already hinted in connection with the construction of bridge trusses, the work is first drawn out in pencil on a cardboard sheet, the various strips being pinned down over the drawing, the small pins being bent over to retain the pieces. If the number of identical trusses is great, it may be worth while to make a jig in which to build them. D and E are roof trusses ; B is a bridge truss, C a trestle bent. In F we have an excellent scheme for the building up of a large-span roof for a warehouse or station where the underside might be visible. For the lower truss, metal strip or even running-rail is used, the truss being attached to a flat piece of plywood on the top surface of which a series of angular wood strips are glued. In normal times this strip can be had from any of the hobby shops. When in place it is covered with a card capping and finished off as slates or tiles, a card mask being also fitted over the ends. The same idea is in J-K. H and I represent roundhouse roof trusses, which are well worth including in a design which has considerable window space. G is an all-timber structure for the formation of effective engine shed roofs, the dummy smoke louvres, capped with half-round strip, being admirable. Needless to state, in all soldered stripwork of this order, the soldered job should be carefully cleaned up with a file, and care should be taken to make every joint a secure one.

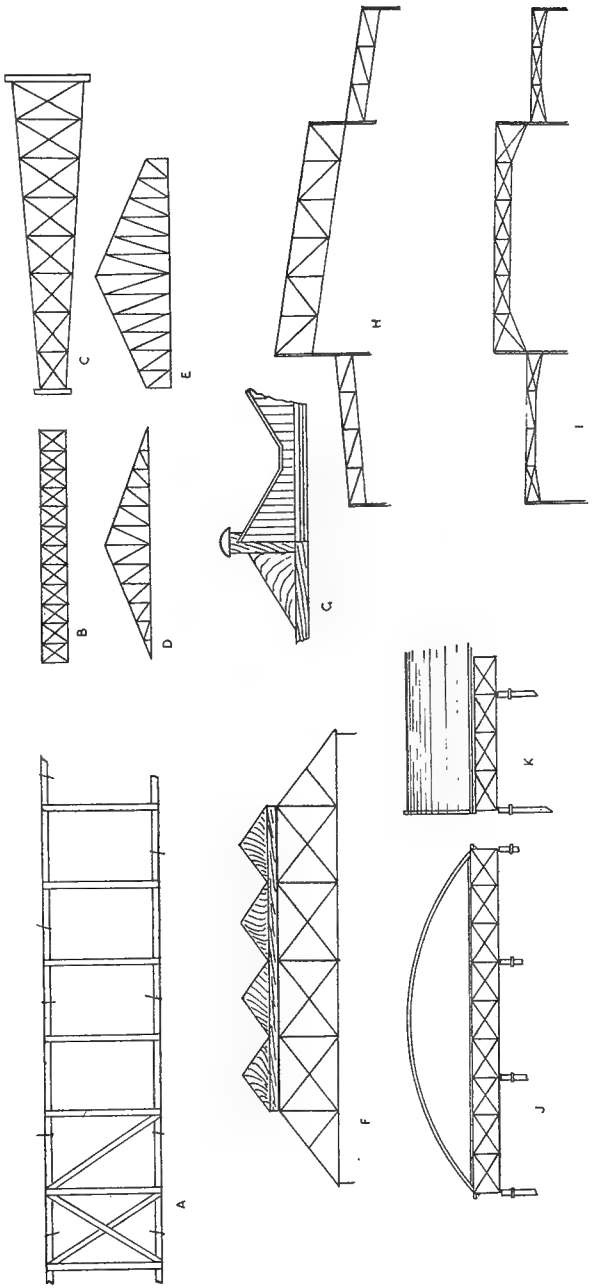
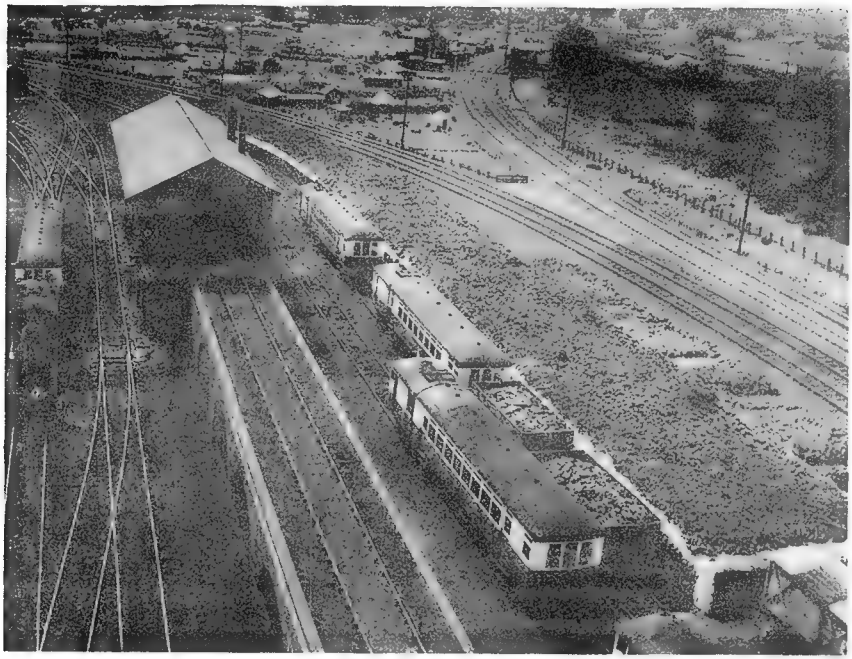


FIG. 30. TIMBERWORK AND STEELWORK



COAL STAGE AND STACK AT BOTANIC GARDENS, HULL (*J. F. Wood*)

LOCOMOTIVE DEPOT APPLIANCES

AN important branch of our subject is that pertaining to the various structural features in and about a locomotive yard—turntables, coaling and cinder plants, locomotive pits and sheers, water tanks and standpipes, as well as all manner of cranes, gantries and derricks.

Among all the tricky constructional jobs on a model layout, I have always considered the turntable the worst. Even assuming that some form of ball-bearing pivot is installed, and the mechanism is made perfect in its smoothness of operation, the difficult problems of track-level will arise. If the tracks are made to register faithfully at one end of the deck, it will almost invariably be found that they do not register when the deck is reversed; and when not one but half-a-dozen tracks are in question, this becomes a complication. But with very accurate workmanship the alignment problem can be negotiated and a manually operated table can be

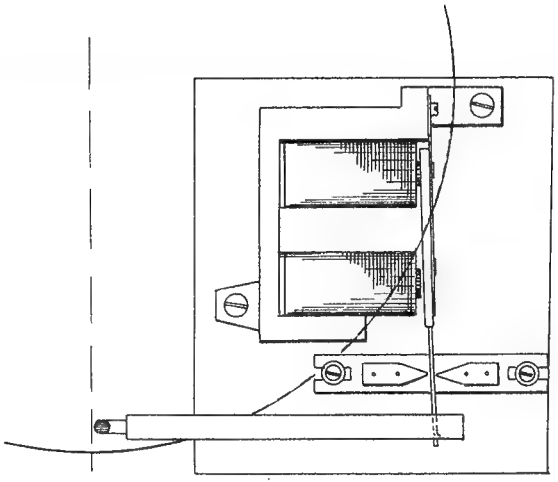
built with success by the average worker. Following upon this part of the job, however, there is the vexed question of power-operation and of automatic or electric stopping and starting of the appliance at desired points, as well as the supplying of power to the tracks.

The scheme that I have found most successful, after experimenting with many, is that propounded by Modelcraft Ltd. in their lineside plan devoted to the subject. Here, the turntable is built upon a cycle-wheel hub, which is admirable for the purpose and can be had quite cheaply. This is adaptable to both a well- and a disc-type of table. The ball-race can be adjusted to a nicety with the aid of a flat spanner, and should be so adjusted as to allow perfect freedom of movement without cant in either direction. A scheme for both types of table is given (Figs. 32 and 33). The mechanism operating the appliance is that of the bell-magnet having a pivoted-loose arm with a pointed rubber tip, which engages a disc below the table and pushes it round very slowly by means of the vibrations which formerly operated the bell. For this purpose, it is necessary to use a 4-volt alternating-current energy, which can be had on standard power units and on that of the commercial system unit known as Trix. The mechanism is absolutely reliable and will drive the turntable almost silently for unlimited hours without a halt. The builder should obtain the Modelcraft prints to elucidate further the method of construction.

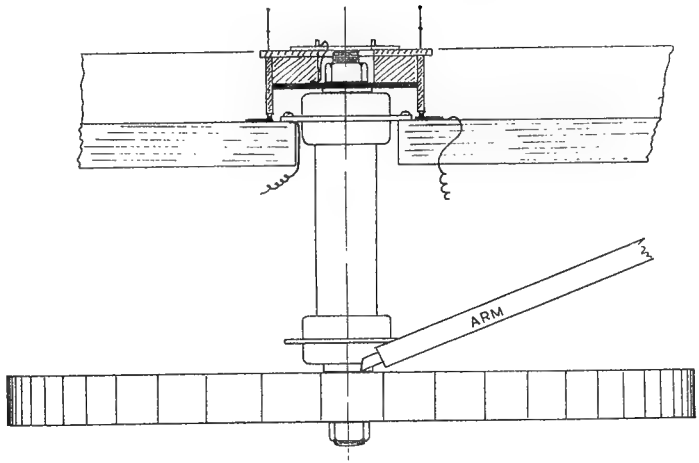
On my own turntables I have devised what I think is an eminently satisfactory form of stop, which is worked electrically, and which has the advantage of operating not on the end of the deck but at the edge of the outer rail on the turntable. This method absolutely avoids all problems

00-GAUGE LOCOMOTIVE SHED BY Mr. J. H. AHERN

FIG. 31. ELECTRIC TURNTABLE STOP



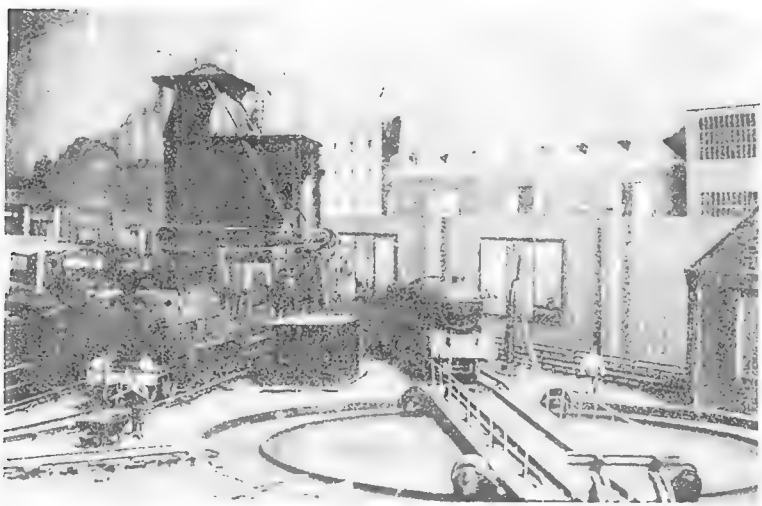
MECHANISM



WELL TYPE TURNTABLE

FIG. 32. MAGNETIC TURNTABLE OPERATOR

MECHANICAL FEATURES ON Mr. W. C. HARDY'S LAYOUT



of alignment from the lateral angle. The stop is fitted to the side of the shed running-rail, and therefore cannot fail to engage the table rail exactly when it is in line. When it has engaged, the mechanism is still kept in operation, so that the sustained "push" of the table holds it effectively in place while the engine is run on or off the track. The stop-appliance

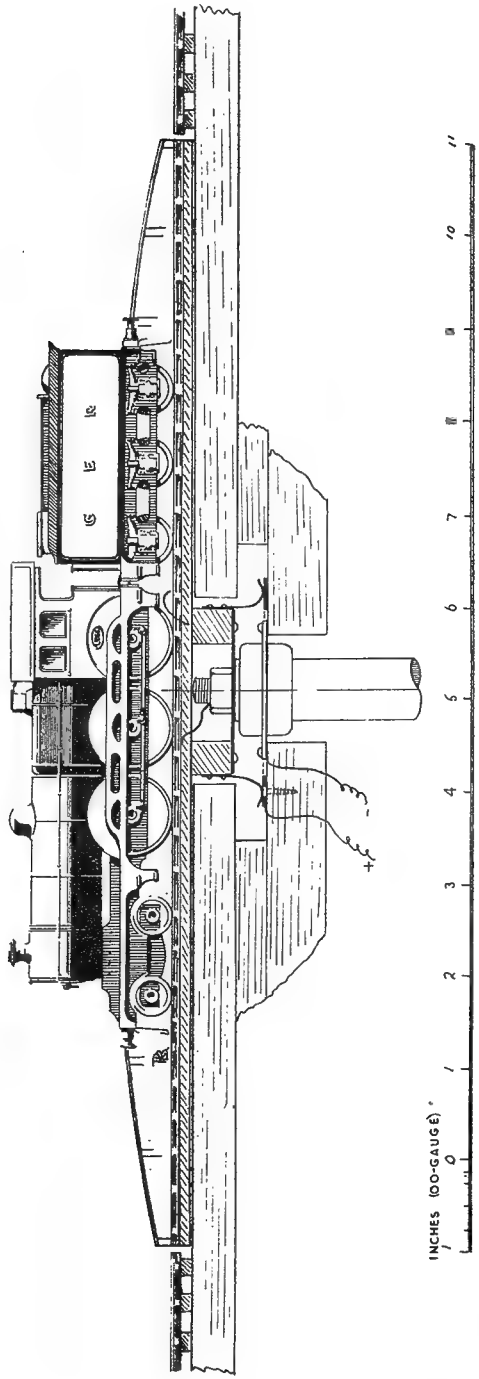
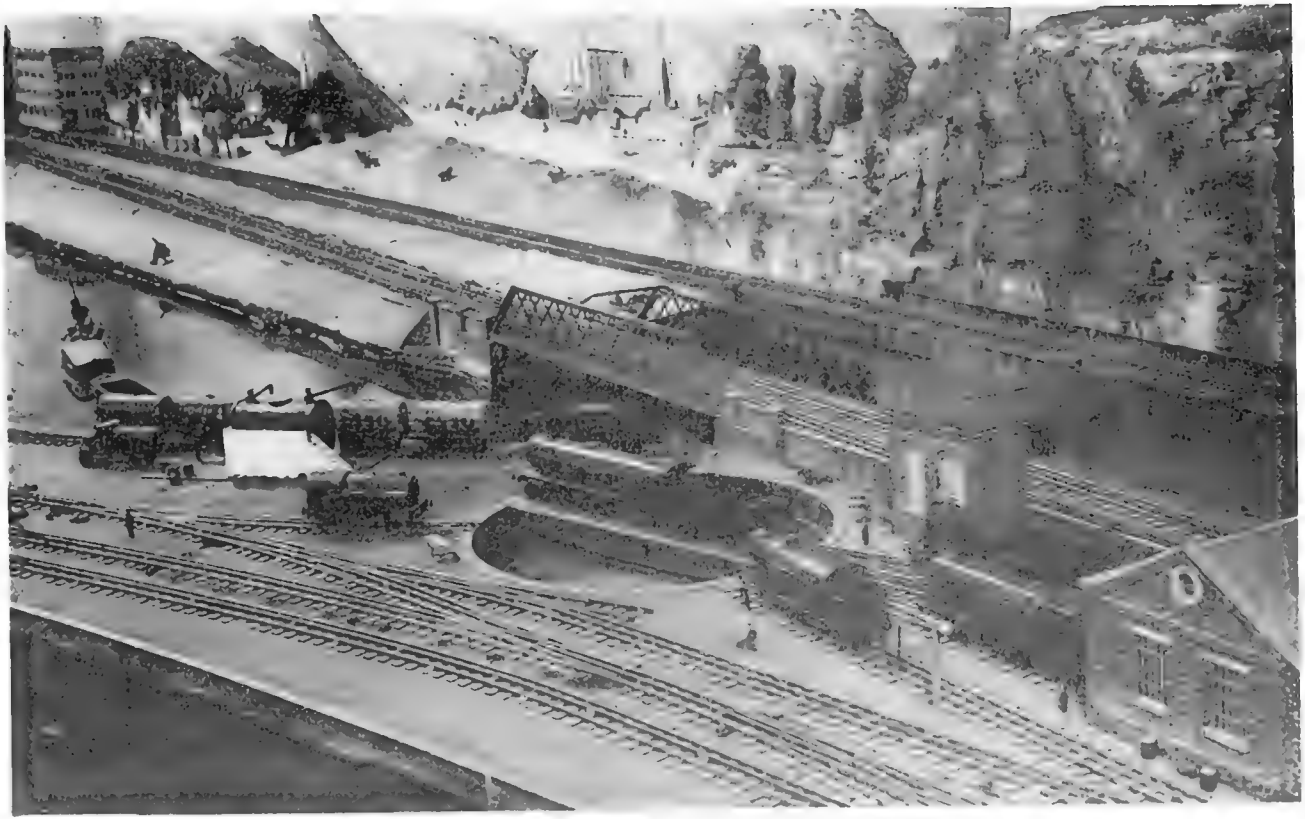


FIG. 33. DISC TYPE TURNTABLE



ENGINEERING WORK IN 00-GAUGE BY Mr. T. H. PEARSON

DEPRESSED CINDER TRACK AT DAIRY COATES, HULL. (*J. A. Wood*)

is easy to make, consisting of a short length of fine-bore tubing with a shaped piece of piano wire oscillating through it (see A in Fig. 31). It can be worked by hand, of course, but it is better operated by a point-mechanism of the cheaper kind, placed under the baseboard. Such mechanisms can be arranged in groups as in B, even where the tracks are close together. It can be operated, along with the turntable mechanism itself, from any remote point whatever; and any track can be selected at will. It also has the advantage of being almost invisible. It must be noted that the disc on which the rubbered arm rests must be at precision level in all positions. The arrangement for a well-type table is shown in Fig. 32, and for a disc table in Fig. 33.

The supply of power to the two running rails is not difficult to arrange. On the well table it is supplied by one element through the bearing, the other through a metal washer (thin brass or bronze) which is rubbed by a pair of leaf-springs on the under edge of the deck sides. On the disc table the pick-up from the metal washer is even simpler. The "disc" of the table consists simply of the baseboard surface painted to represent concrete, and the tricky part of the work with this type is to maintain an even clearance at the ends of the deck. On the well type this problem does not arise. The disc-type deck takes an arched plate girder; the well type has under-girders and hand-rails.

Of coaling appliances there are endless varieties ranging from the old-style platform and barrow to the modern wagon lift or tipple. In Figs. 34 to 37 three types are illustrated, and the choice will depend upon the general style of the layout and the requirements of the locality. The standard type shown in Fig. 37 will not be required unless at some very large divisional depot where over a dozen or so engines are kept. The platform and tank type shown in Fig. 34 is also only suitable for a depot of some magnitude. The most useful and truly characteristic design would be that of Fig. 36, for the average modest system, and this form of concrete skip-hoist plant can be installed either as a single unit or in duplex. In any event it will, of course, be a dummy; so there is no need to model the skip unless specifically desired. The hopper-cavity might be included for the sake of good appearance. The model is easily made up from solid wood strip and small parts. The base of the chute, on the front wall, is shaped from an 0-Gauge signal base.

For those who wish to build an operating example, the design of Fig. 37 should be a temptation. This represents the wagon-tip and skip-hoist type, to be found at Perth and many other large centres. It is hand-operated as a model, but has all the essential movements for retaining

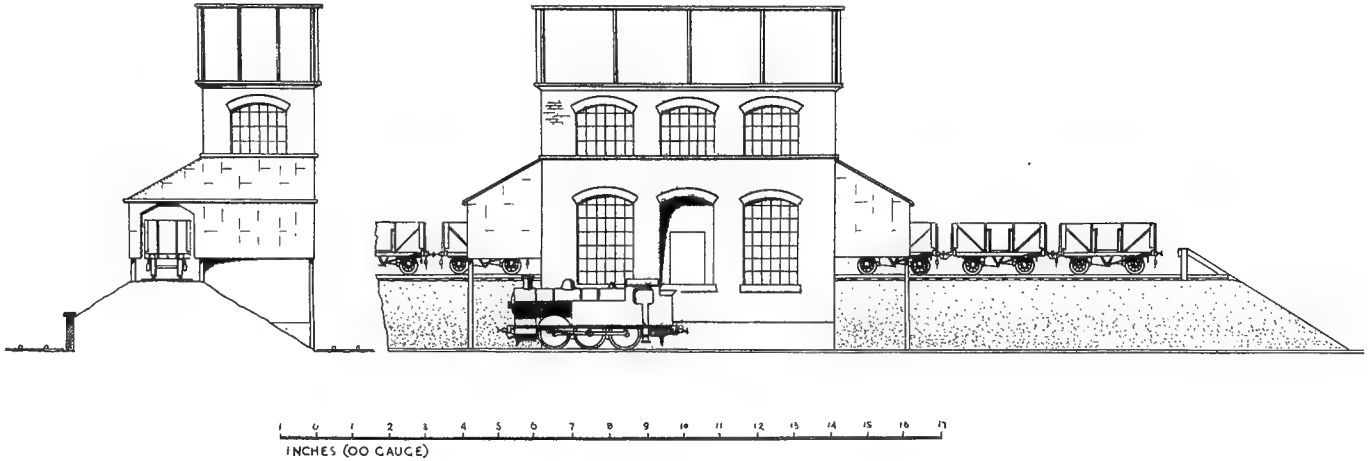


FIG. 34. COAL STAGE WITH TANK

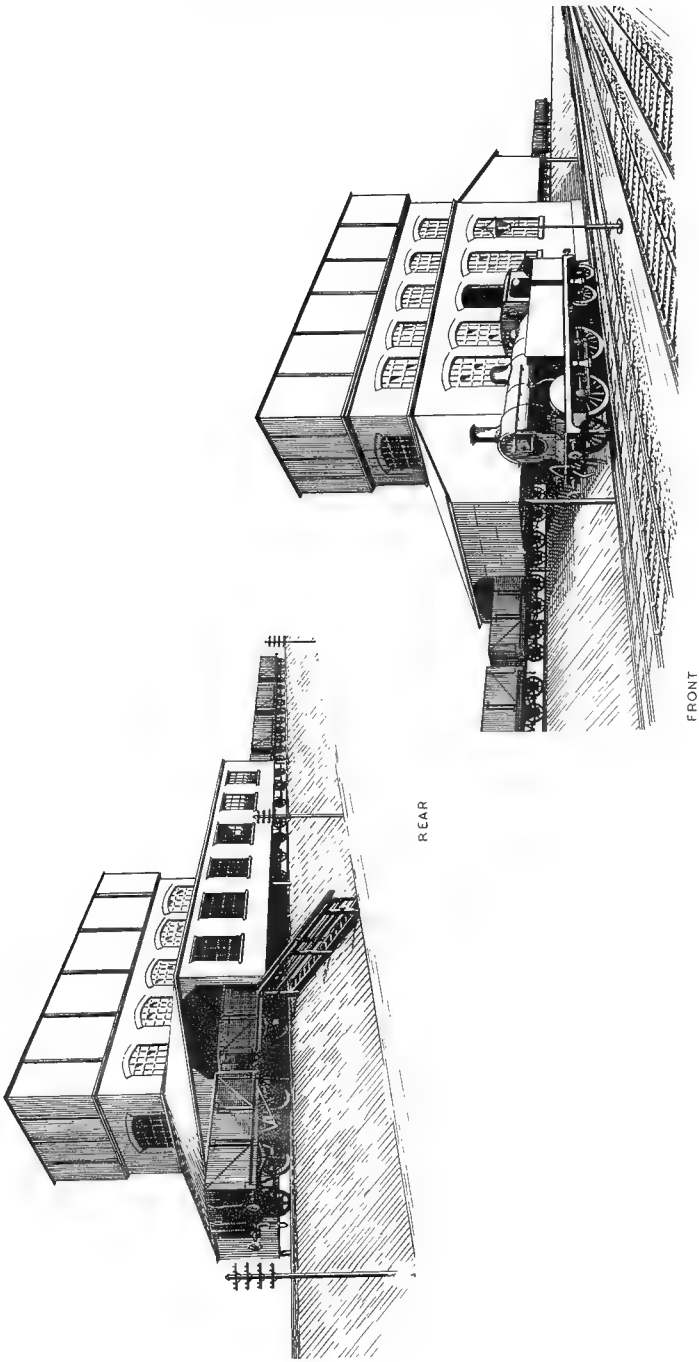


FIG. 35
COAL STAGE WITH TANK

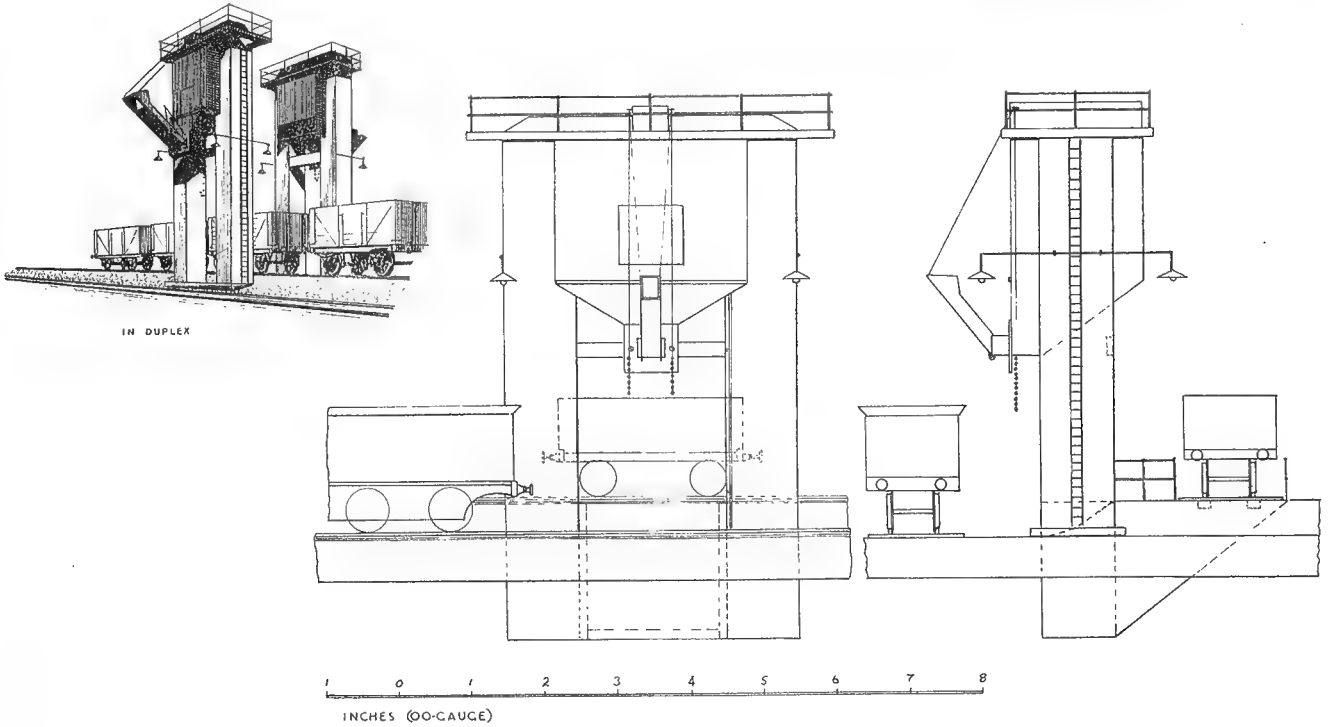


FIG. 36. LIGHT CAPACITY COAL STAGE

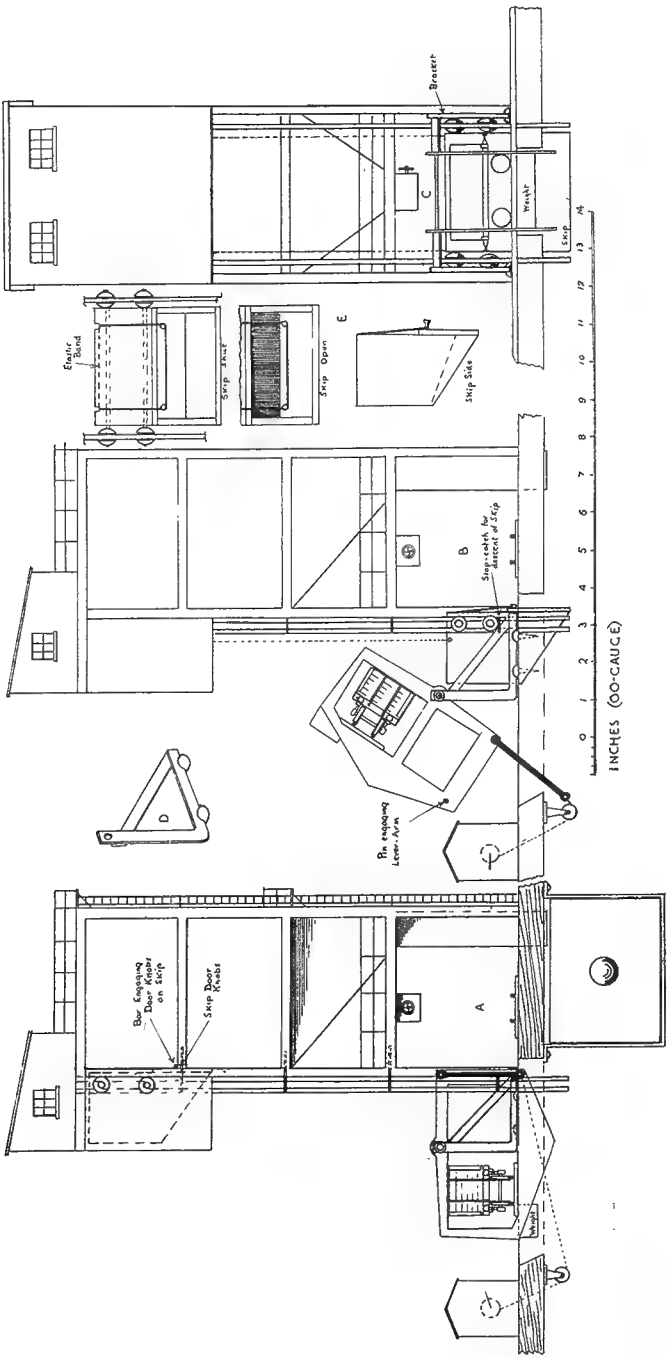


FIG. 37. WAGON AND SKIP COAL STAGE

and tipping the wagon and for manipulating the skip, so that actual coal can be brought up and dumped, and raised into the bins. It then discharges through a concealed chute into a receptacle below the baseboard, from which it can be taken back to the minehead. The drawing is largely self-explanatory. Pulleys on the skip are Woolworth curtain pulleys. Wagons to be used on the tipple must be all of one standard height to slide snugly under the retaining bars. I have operated a similar tipple to this with 100% success for years.

A light capacity cinder or ash plant is shown in Fig. 38, and this should match up well with the small-capacity coaling stage for the average layout. It is practically an all-metal structure, with the exception of the concrete hopper walls at the base. For a dummy model, the skip is again omitted, though the hopper below the cinder pits is included.

Standpipes and water tanks are important, and the former especially should if possible conform to the practice of the company represented in the layout. Two full-size designs for standpipes are given (Fig. 39, A and B). In A we have a useful freelance type which is very easy and interesting to build. The base is of thin wood. The drain-grating is a special kind of button which can be chosen from various patterns if the worker keeps his eyes open. One very good type is rectangular with rounded corners. The manhole lid is one sold for use on an 0-Gauge American freight refrigerator car. The base of the column is a piece of cartridge case soldered outside an 0-Gauge angle-crank base, with a shoe-eye soldered on the top. This eye receives the column, which is a length of Mecanno rod. The rod is shaped accurately with pliers or in a vice, but before making the final bend on the upper end all the shoe-eyes to form the flanges should be forced on back-to-back. The dummy wheel-valve is formed from a 00-Gauge brake wheel soldered on a blanket-pin (these can still be had), the head of the pin serving to represent bevel-gear with the head of a second pin at the opposite end. The appliance swivels about the point indicated. The other design is made largely from similar materials, with the aid of metal balls obtainable from material suppliers.

In Fig. 40 we have further examples of small features for yards. These include water tanks of the rectangular and circular type, locomotive sheers for the raising of a unit in order to gain access to one end of the underside. There is also a sketch of a water standpipe suitable for use on the end of a station platform. This is made very much in the same way as those already described. The circular tank is built from odds and ends of scrap, including a discarded tobacco tin. The tablet bearing the figures for the depth gauge is taken from a calendar, on which it is often

FIG. 38. LIGHT CAPACITY CINDER PLANT

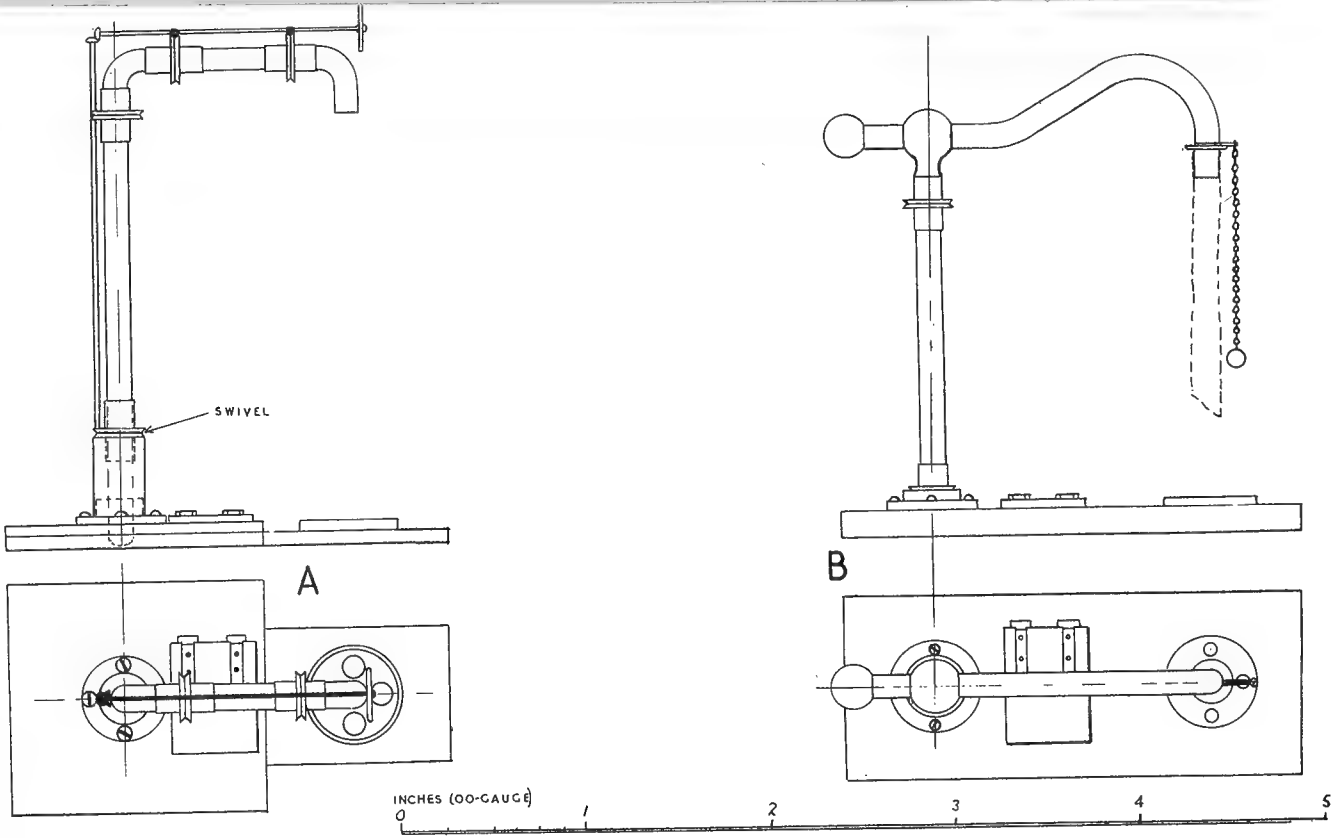
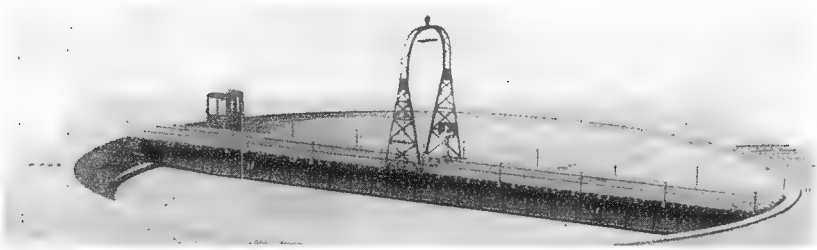
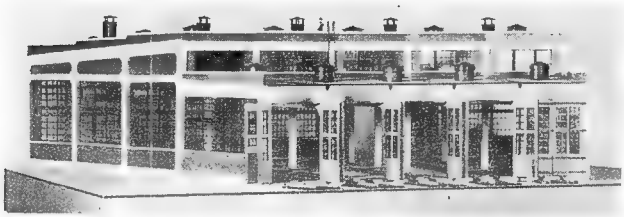


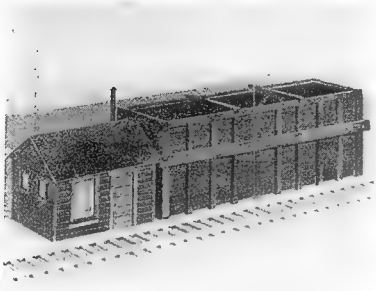
FIG. 39. STAND PIPES



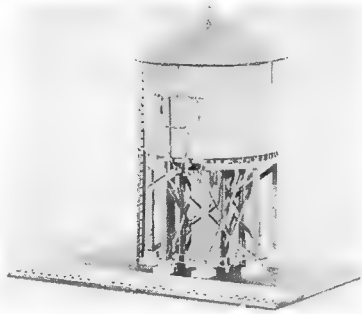
110 ft. TURNTABLE



FIVE STALL ROUND HOUSE



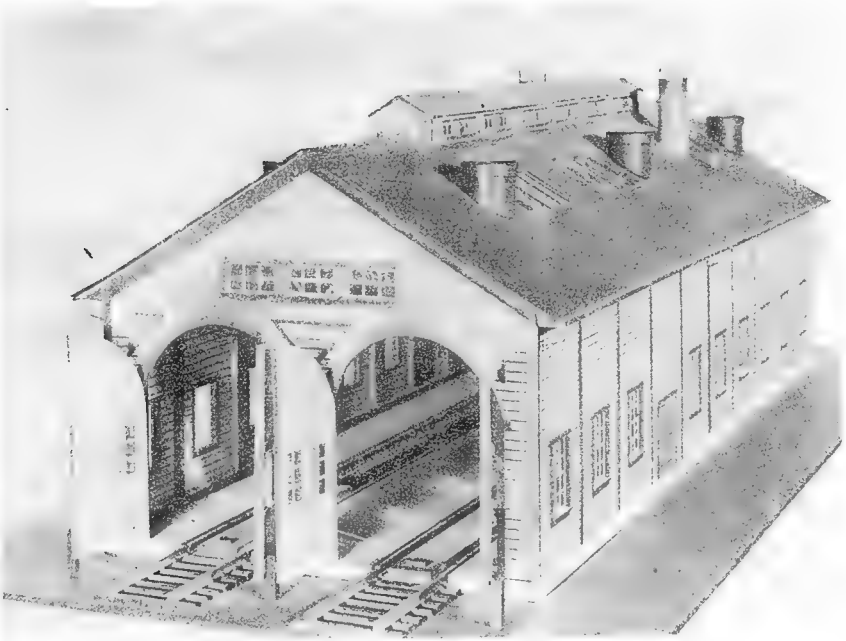
SAND BIN AND DRIER



SPOUTED WATER TANK

0-GAUGE LOCOMOTIVE EQUIPMENT BY MODEL STRUCTURES CO.

possible to find such numbers to a vertical spacing of exactly 4 mm. The column is a short length from a tapered pen-holder. A soldering job is necessary in making the sheers, which are built from $\frac{1}{8}$-in. square brass strip. The slightly enlarged diagram of the chain-blocks will serve to show the correct arrangement for the pulleys. These are actually Leeds 0-Gauge signal pulleys, and sets of blocks are simply soldered up without



0-GAUGE DOUBLE TRACK SHED BY MODEL STRUCTURES CO.

the introduction of spindles; the chain is commercial. In building the rectangular tank it is possible to use for the tank body a high-capacity wagon block in wood, such as used to be sold with litho papers. Note the I-irons used for bearers. The same material is used for the tracks of the inspection and cinder pits, the I-girders passing longitudinally exactly under the rails, to which they could be soldered. For two-rail, it will be necessary to use for cross-bearers some of the commercial I-strip in wood for the securing of insulation. Inspection and cinder pits are much the same, though the former may be rather deeper, and the latter will, of course, simply run sideways out of a deeper track-hopper cavity.

Passing on to yard and other cranes, we have in Fig. 41 a type for a goods yard bank, and a plain derrick. Brass strip is the best material for all these heavier mechanical features, though lighter strip, such as running rail, could be used for the large gantry of Fig. 43. The advantage of metal strip over wood is mainly in the fact that it is heavier, and gives the model a better stability. In those instances where the mechanism runs on tracks, the best method of building up the running gear is to use

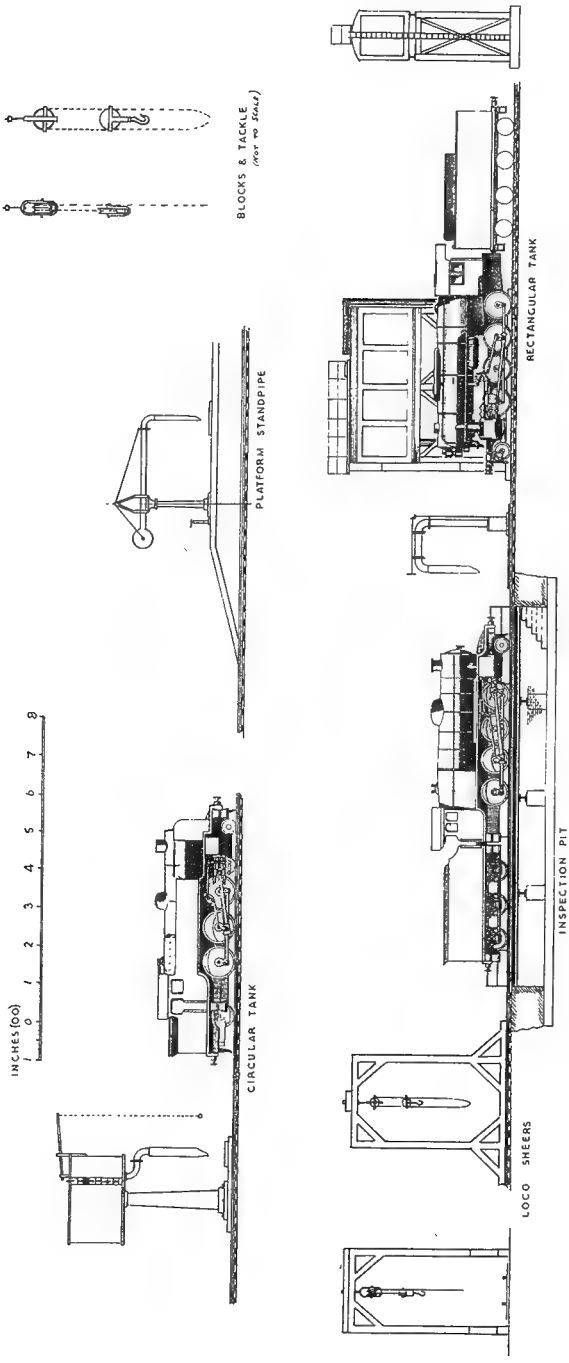


FIG. 40. LOCOMOTIVE YARD DETAILS

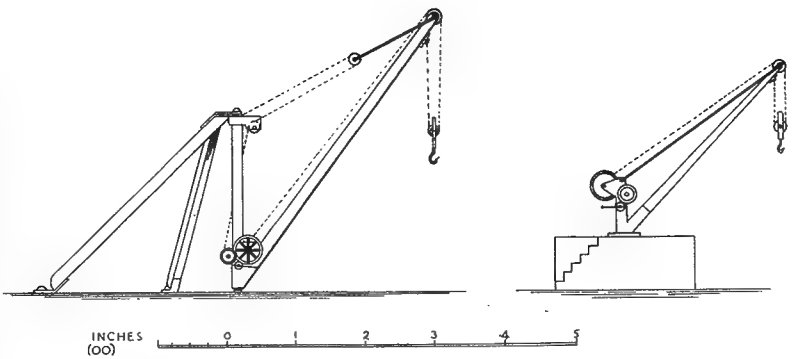


FIG. 41. DERRICK AND YARD CRANE

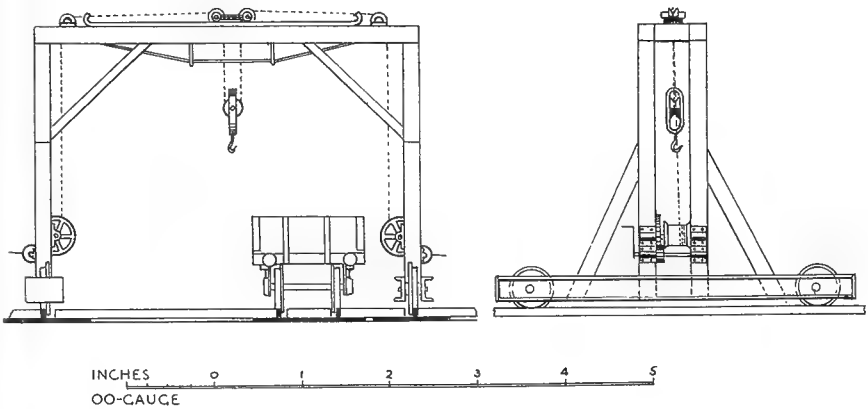


FIG. 42. GANTRY

brass channel and solid wagon wheels, the smaller the better. American disc wheels are much smaller for this purpose than British, and HO-Gauge wheels must not be forgotten. The hoisting mechanism of Fig. 42 is a dummy one.

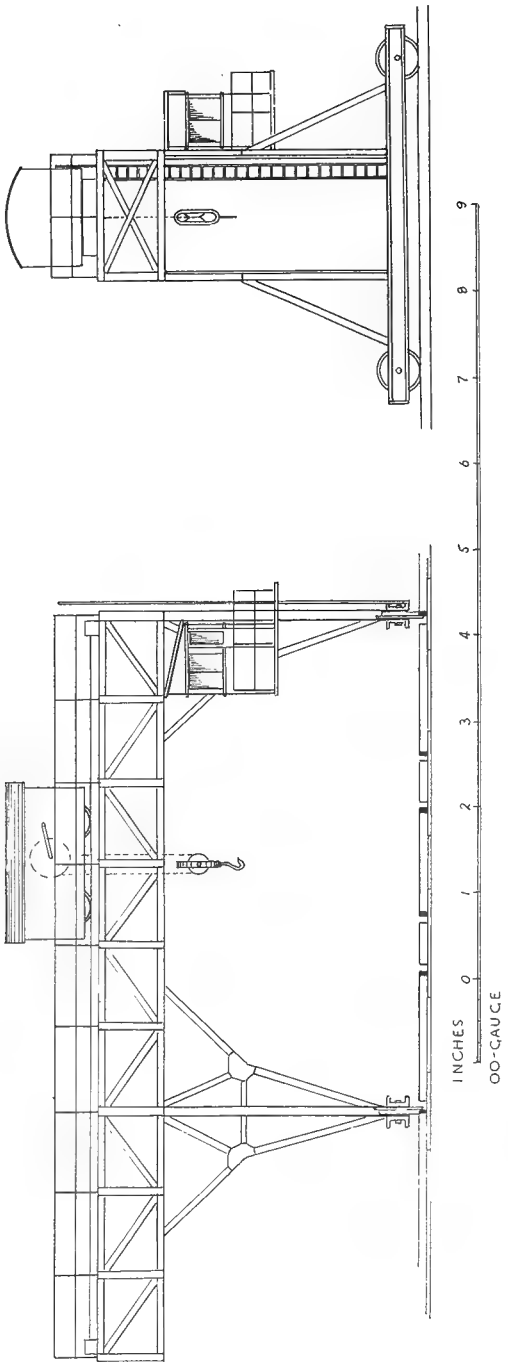


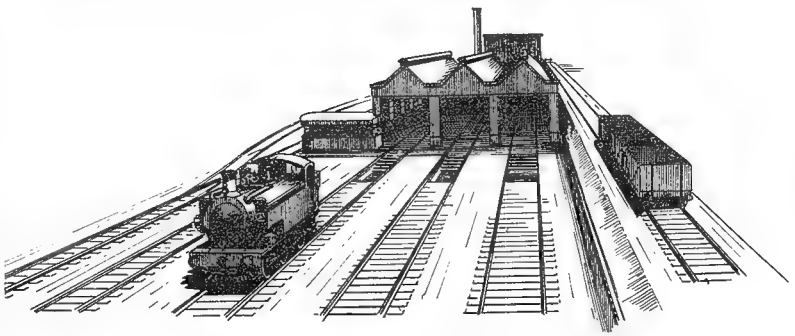
FIG. 43. LARGE GANTRY

PAINTING AND FINISHING

FOR all exposed iron and steel work on a layout, the best and most correct colours are black, dark grey and red oxide, though P.W.D. brown is not unsuitable. In all cases, the paint must be of high quality, if possible fresh, and capable of drying definitely flat and without gloss. Perhaps the best colour for painting track-rails and sleepers is a dark brown, though black is almost as much to be commended. A mixture of red in the brown is realistic on rail and on chairs. A variation between the metal and the wood, in colour, is excellent on track.

For imitating concrete, granted that the correct type of paint is used, there are two distinctive concrete shades, the grey and the brown, and of the two I myself much favour the brown. An all-concrete finish can be somewhat unconvincing unless it is weathered a little so as to relieve the monotony, but when properly treated and applied this finish is really excellent, being also the least troublesome of all finishes. On the surface of turntable pits and discs, on pit walls, track-hopper walls, and on all those many yard features which are nowadays built in the material, of course there is nothing else for it. Engineer's blue brick-paper must be thoroughly weathered and smeared to appear correct. Concrete is also used for modern types of platelayer's huts, telegraph poles, fences, edge-kerbs, and other details.

A fine finish for timberwork as on trestles and bridge decks is creosote. Nothing looks so satisfactory, and if it is not obtainable, several coats of diluted permanganate of potash will do the deed.



INSPECTION PITS

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ARCHITECTURE

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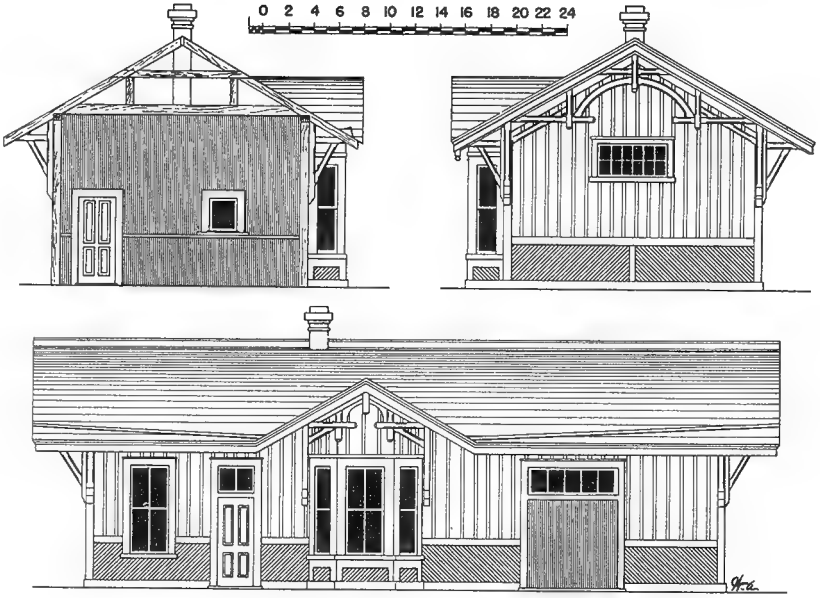


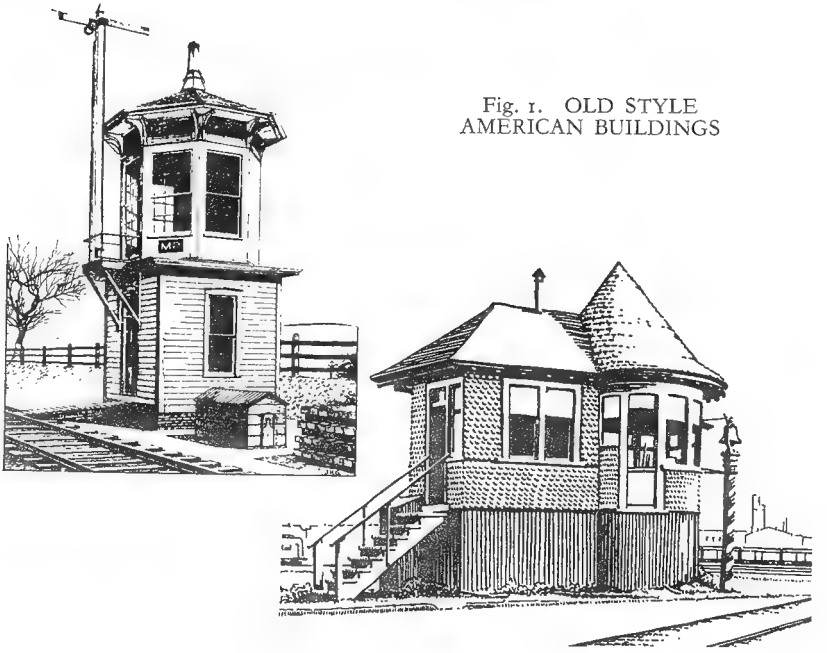


Fig. 1. OLD STYLE AMERICAN BUILDINGS

RAILWAY ARCHITECTURE IN GENERAL

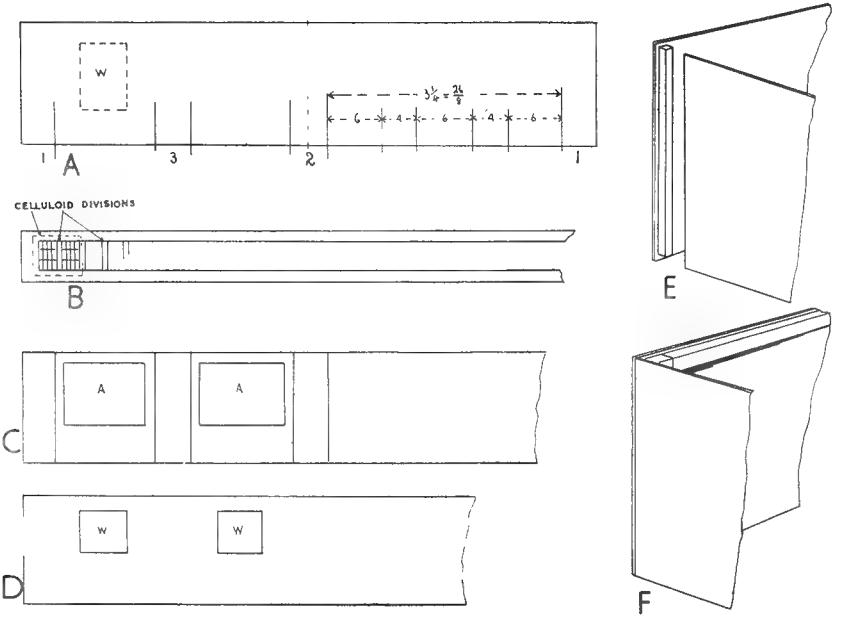
RAILWAY architecture bears characteristics which are essentially its own and which set it apart from all other forms of architectural design. Of necessity, it has much in common with the larger art, for within the limits of the life-history of railways, the same laws of periodicity will apply. For the scenic modeller, also, who has to consider railways in their architectural relationships, the same principles of residence- and factory-design will apply. But it is fortunate that since the history of railways covers only about a hundred years, the range is thereby strictly limited.

There are in the design of all railway buildings as such certain characteristics which are intrinsically peculiar. This is notable, for example, with regard to American railroad bu.ldings especially. In the early days of the railway these buildings were literally like nothing else on earth, and carried a certain romanticism which is still strangely attractive (see Fig. 1). While our home railways may not have ever been so definitely set apart in their style, they, too, bore a vast amount of originality, particularly with regard to the constructional lines adopted by the many different companies.

Our range of outlook in setting about the task of modelling these buildings and structures may be understood to embrace all manner of railway edifices in brick, masonry and timber, concrete and metal, with the exception of bridges and engineering features. So much for the railways themselves; but we must include, by reason of our desire to be faithful to the whole atmosphere of the railway, those types of buildings usually found adjacent to the tracks and forming part of the general scene —villas, churches, inns, shops and factories. It is, let it also be noted, in this latter outreach that our interest is carried beyond the single century of railway history, away back to the earliest days from which any such buildings may still be found intact.

It will therefore be conceded that, once more, the initial duty of the modeller is that of consistency. A layout representing an early period of history will be restricted to those types of buildings which obtained up to the end of the period in hand. If the railway represents the Highland Railway during a given couple of decades, the style will rigidly follow that period and will scrupulously avoid the immediately modern.

It has taken the fraternity a considerable time to produce really creditable and convincing work in railway architectural modelling. For many years the efforts of workers were somewhat crude and often childish. Even today the examples of marked excellence are few and far between, and much the same may be said of the work in America. No doubt this deliberation has been due to the persistent notion that railway modelling consists exclusively in designing and operating trains. The best method of exploding this idea has been the contemplation of such handiwork as that produced by such workers as Mr. John Ahern, whose book upon the subject—*Model Building Construction*—is heartily commended to the enthusiast. Even the commercial houses have now begun to go much further and to do much better, though until recently the greater credit in this respect was due to America. The firm known as Model Structures Co., of Santa Cruz, has always produced first-class buildings and components for 0-Gauge, and has recently begun to cater for the smaller standards. Star Line and Tru-Scale are now putting on the market some very decent material; and latterly British sales have been enriched by the products of Modellers Supply of Huddersfield, known by the name of Anorma, some sketches of which appear in this handbook. But there is still unlimited scope for the commercial man and the amateur alike.



RUDIMENTS OF THE MODELLER'S ART

There are various accepted methods of producing the required buildings for a layout. They may be constructed in wood, cardboard or metal, or even in solid timber. The somewhat uninteresting details of Fig. 2 will give some of the first steps. A is a length of cardboard or similar material cut for a wall in which windows are to be inserted. The method of marking out the apertures is shown. It is a simple matter of course to calculate the number of windows and their spacing and to cut the apertures accordingly. But occasions will arise when it is the length of wall which is the predetermined factor. In this event, a start should be made as indicated, the first steps being marked 1, 1, marking off the width of the required spacing from the ends. In 2 we have the second step—to mark the centre space. Working now on the left side only, 3 is the third step—to mark another central space between the two inner edges of the outer ones. Your windows, whatever their appropriate sizes, go in the centre of the spaces thus made. Another method is shown on the right-hand side. Here, after the two outer spaces are marked off, the total number of spaces required, together with the portions between them, are ascertained. The width between the outer lines is $3\frac{1}{4}$ ins.; otherwise 26-eighths. This is divided by the number of eighths in the spacing required and accordingly set out. This method is suitable when the number of windows is odd rather than even.

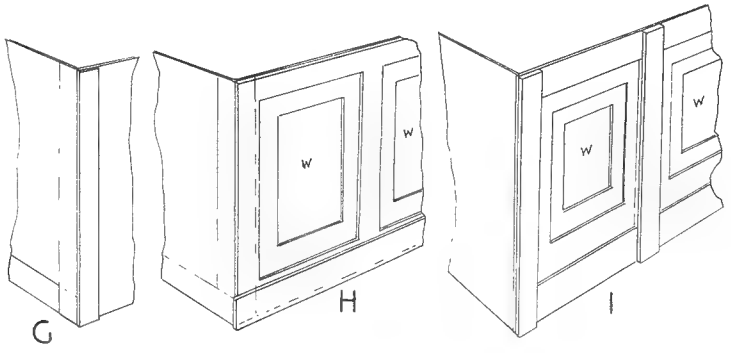


Fig. 2. (*Above and on facing page*) WALLS AND PIERS, WINDOWS

In B we have the simpler method, and a scheme for forming windows which avoids a lot of cutting out. The strip is cut as shown; a whole length of scribed window celluloid is glued on the back after suitably treating the edges of the apertures which, on the whole, are best left white. Then insert short strips of card to form the spacings between the windows, taking care that these precisely fill up the spacing of one or more sashes. In C, we have a wall with piers and large windows; in D a wall without piers and with small apertures.

The method of forming the corners of buildings is important, the two outstanding things to aim at being strength and sharpness. E shows one method—perhaps the best—in which a strip of wood is glued exactly in place on one wall to receive flush the end of the other wall. These strips should come short at the top and bottom in order to take the ceiling and floor inserts, another strip being attached lengthwise to take the two latter. In G, the method is to connect the corners with adhesive tape, and to cover the tape later with card-strip to represent piers. Similar strips of tape can be attached to the base and later lapped over as shown. In H, the pierced wall is in two parts, one forming the windows, the other forming a fascia in front of it, the fascia in turn being provided with a skirting or plinth of card. In I, the wall again has two thicknesses, one for the windows, another for a fascia, and this in turn has the piers and plinths worked up in card-strip on the surface. These various methods are all adaptable to most buildings, whatever their type.

A very reliable method of joining walls is that adopted by the commercial Anorma kits, where the material is $\frac{1}{8}$ in. thick planed and dressed wood. Here, of course, the ends are simply jumped and glued together. The disadvantage of this method for the modeller who has to cut his own material is that a thickness of $\frac{1}{8}$ in. is far too effort-demanding when window openings have to be cut. And such an excessive thickness is quite unnecessary for buildings in the smaller scales. One-sixteenth, or even less, will stand up to all the demands of permanent use, even without the aid of shellac, if the right kind of card is employed.

Roofwork is very important as a feature of modelling and there are scores of varying roof types. In Fig. 3 some of these are shown. I have first shown a roof soffit—a favourite method of my own wherein the eave-guttering is glued to the edge of a flat sheet of material covering and overlapping the building. Beneath this flat piece there is glued another which fits snugly inside the upper edges of the four walls, holding the whole structure rigid. On the top of these two sheets there is glued

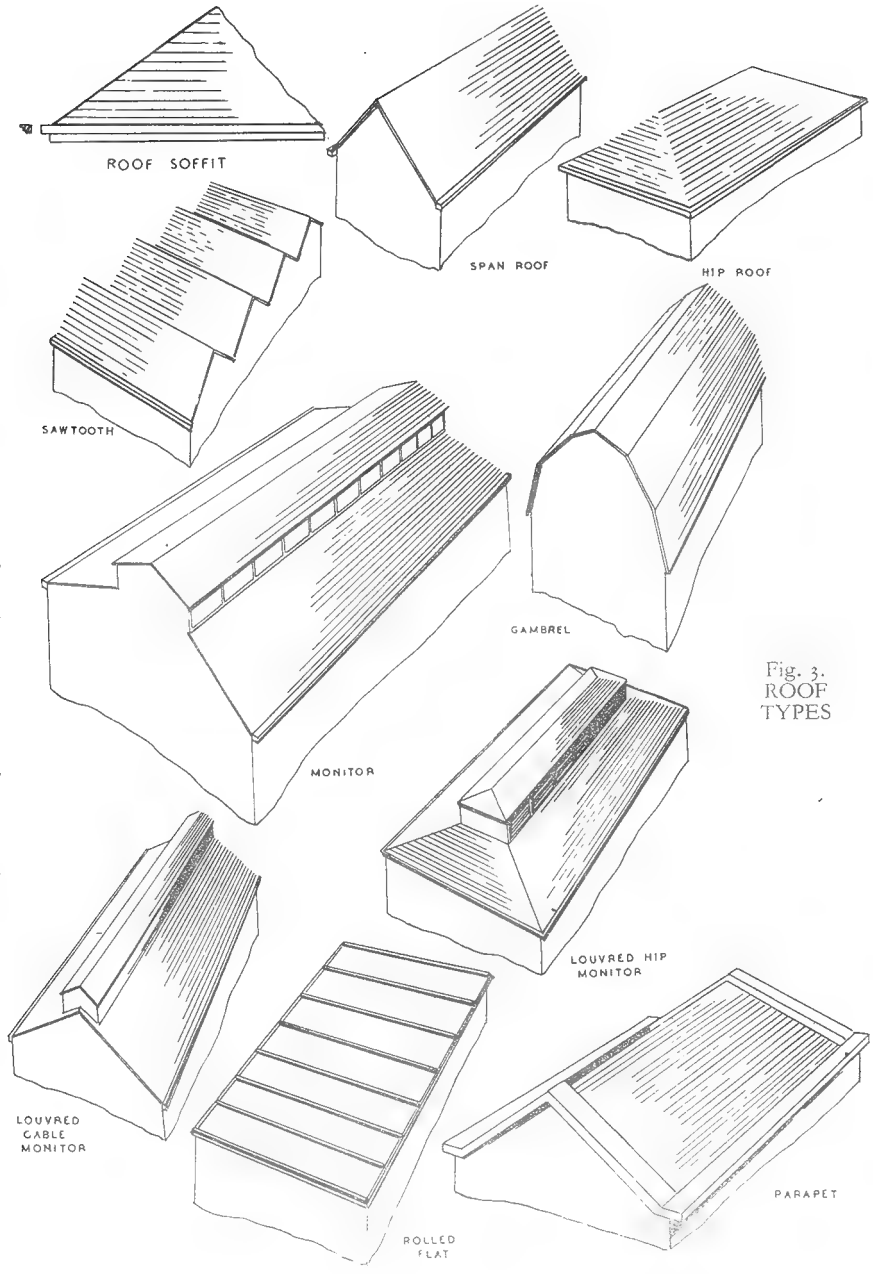


Fig. 3. ROOF TYPES

the roof itself, the lower edges being held down with temporary pins driven only very slightly in, and removed when the glue is set. I have made thousands of roofs in this way and have never known a collapse. The plain hip roof is the common type, along with the plain span roof. The saw-tooth roof described is actually a multiple-span, the truly saw-tooth roof having one edge of each " gable " perpendicular. The gambrel is elegant in appearance and easy to model. Monitor roofs are very common on railway buildings and have a very striking effect if the monitor sides are provided with glazing. Sometimes the monitors are louvred as also shown, and may have either hipped style or the gabled. The rolled flat is easy and effective, the rolls being simulated with medical applicators, the whole surface being painted to represent lead. The parapet is the hardest to construct and the best in appearance. Its difficulty is, however, more apparent than actual; for the parapets themselves merely consist of lengths of strip-wood mounted upon a plain span or gable roof.

Fig. 4 gives various details and suggestions regarding windows, doors, plain chimneys, dormers and skylights. A and B are important. They depict a new type of commercial window and doorframe produced in plastic by Sky-Line of America. These are scaled for the smaller standards and are excellent. The shaping of the frames is such that they are provided with inset beadings which slip precisely into the apertures and completely cover the edges with chap-boarding. The windows are produced in a variety of styles and shapes, and there are several types of doors. The celluloid is simply attached inside in the usual manner. In C we have the earlier type of window consisting of scribed celluloid, and in the diagram the mullions have been included. They can be formed with fine strips of white paper glued on the surface, and are an essential feature if accuracy of finish is desired. Mullions are also included on the door in D. E and F shows how to represent the common sliding-sash house window. In F the window is modelled as open at the top, this being easily done by lapping a cut section of the celluloid and framing over the top of the lower sash. For the hinged open sash in G, one sash section is cut on three sides with a razor-knife and the sash bent upwards at an angle. The full-sash swung open in G is similar. Skylights can look extremely ugly and unconvincing if not correctly modelled. They may or may not come right to the top of the ridge, but they should have no beading or framing of any kind along the bottom edge. A method of conveniently fixing dormers is shown in J. The nearer sketch shows a dormer window in place, secured by

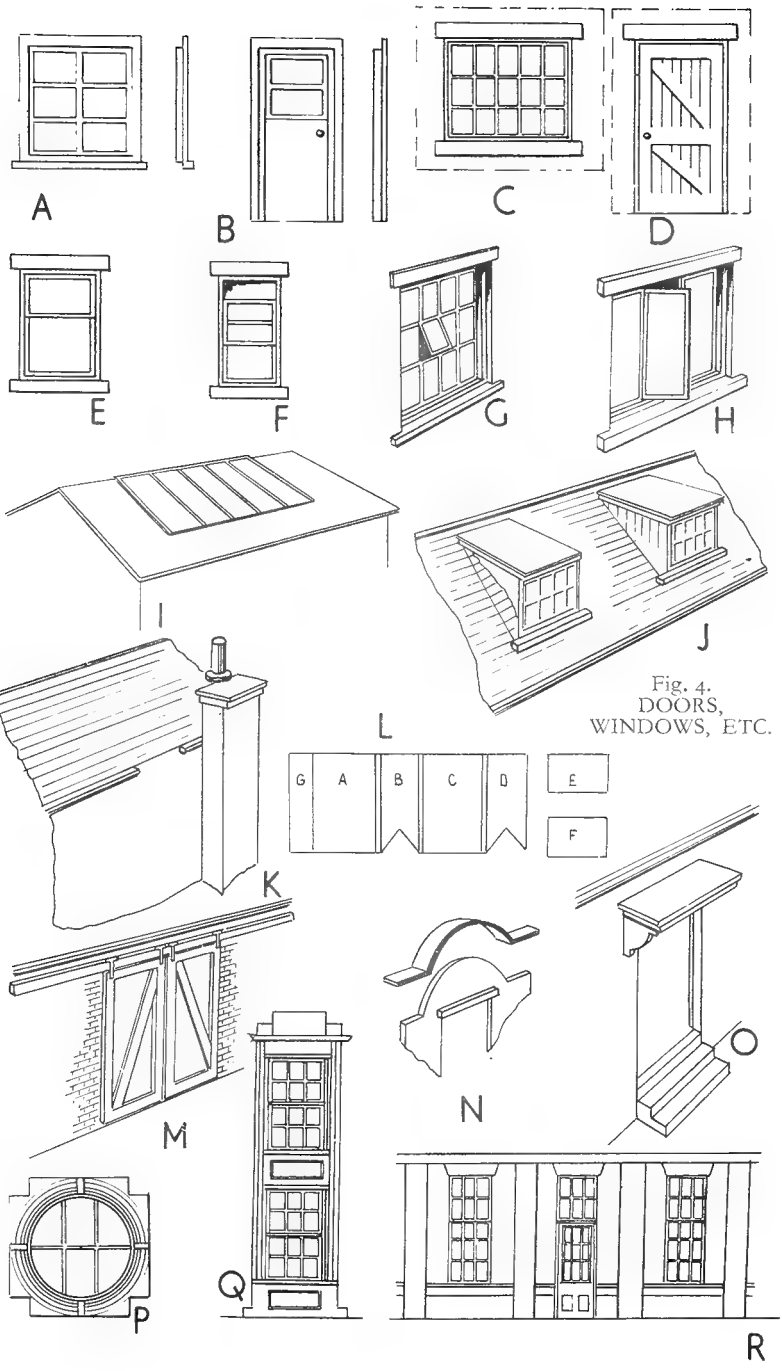


Fig. 4.
DOORS,
WINDOWS, ETC.

lapping on its sides a piece of the roof-paper employed for the roof. This makes a stronger job than a glued edge, and it is later covered, as in the second sketch, with a thin surfacing of card, lined and painted to represent timber. The common form of chimney stack for a villa is shown in K, consisting of a length of stripwood let into a gap in the guttering and glued to the wall. The best chimney-pots I know are made with aluminium rivets to correct size, which are exactly to shape. The built-up form of chimney, as used on a roof ridge, is indicated at L. A, B, C, D are pieces of cardboard glued to a length of brick-paper and cut to shape, a gap between each to allow for bending. G is an overlap of the brick-paper which is left to bind the whole together. E and F are soffits for the top and bottom inside. Use the cut-and-try method to secure the angle of the roof, then cut the remaining chimneys from a template. Sliding doors, such as are used on machine-shops and factories, can be modelled as at M, and it is possible to obtain for a few pence these doors ready made. An ornamental eave-window is shown in N, consisting of an extension of the wall, correctly cut and shaped, covered with a card capping. A plain house porch is to be seen at O, and a fancy oriel window at P. Such windows appear frequently on more or less ornate modern station buildings and can be represented simply by the shaped foundation of card having the rings drawn on. Q is a suggested ornamental window for a two-storey station building, and represents an actual type at Romford, Kent. The modelled effect of such window work as this is very striking. In R will be found a section of wall and window of the type often used on station walls facing platforms, where the building is fairly large and modern.

Further useful details may be found in Fig. 5. A and B show gates for front garden walls, the gates consisting simply of part of the wooden wall-material, which, covered, let us say, with brick-paper, has the gate left bare and painted after the details are added. The gate posts are simply attached on the front with glue in A, and in B are lengths of stripwood with slots cut to allow them to slip over the thinner wall-material. The method of forming a bay-window is shown at C. The scheme is self-explanatory. When the tabs have been bent over and glued, they should be further held with adhesive tape. Fit the " glass " before fixing the bay. Paint the inside part of the wall behind the bay black, or, better still, cover it with blackout paper. The structure of an eave-window is shown at D, and at E we have a useful commercial component used to form an ornamental cornice for a house or factory, or even a station. This

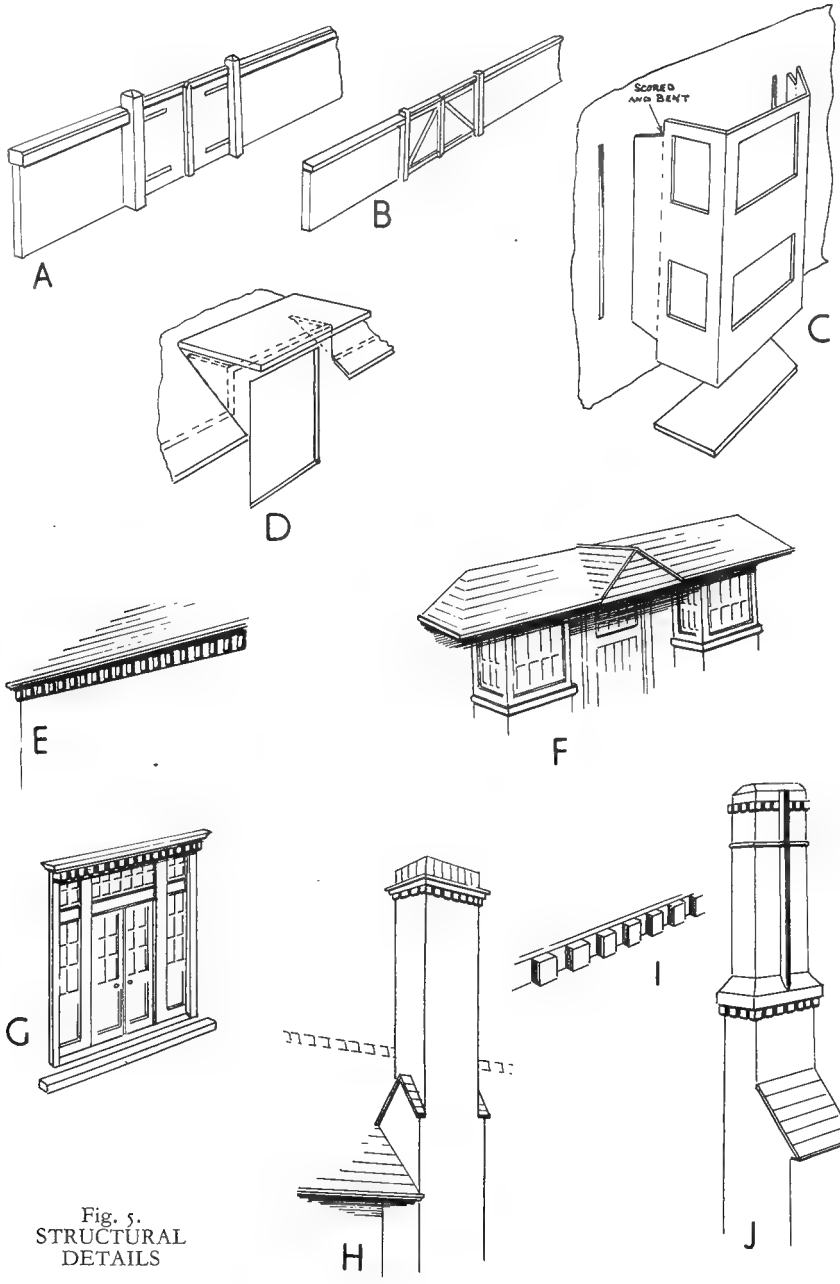


Fig. 5.
STRUCTURAL
DETAILS

material (I) can be had in 2-in. lengths and in various sizes and is invaluable. In H it is employed around an ornamental chimney-stack, as it is again in J. Ornamental chimneys are an art unto themselves, and the worker is referred to a small handbook entitled *How to Draw Houses* (from which these two ideas have been roughly adopted) which is published by Studio Publications Ltd. This book contains many valuable aids to detailed ornamental villa work.

Some details of construction for such buildings as churches will be found in Fig. 6, and embrace nothing that is not exceedingly simple. The method of forming a church tower or steeple is seen at A. The lower square is first formed, the upper louvred portion being let into the top of it. The cornice around the lower tower is simply made from stripwood with an ornamental card-strip below it. It may even consist of a plain square frame cut from one piece of card. The louvres are formed from strips of card lapped over one another. The conical roof fits inside the upper tower and has a plain cornice. The lower walls are covered with old-stone paper, and the arched windows have tiny sashes formed by stretching pieces of fine veiling at an angle in front of the plain celluloid. Wall buttresses can be built in card-strip or stripwood as at B. In C we have the formation of an ornamental parapet roof. The lower moulding can be had commercially like the cornicing; the parapet is built of wood-strip. D gives a section of the work. A porch like that at E is quite plain going, and F gives the method. The steps should be made first, after the door itself. The sloped roof is best made from a piece of wood angle. G and H are steeple tops, the first being finished with golf-tees and short lengths of dowelling, the second introducing 0-Gauge signal finials, a golf-tee in the centre.

The builder of a layout will early find himself confronted with the task of making yards of fencing of different kinds. There are correct and incorrect ways of executing this work. The standard railway fencing is shown at the top of Fig. 7. It consists of four wooden rails attached to upright posts having corner braces. To make this from stripwood and glue is not impossible or very difficult, but trouble will be had in getting the glue to hold the rails to the posts. A cheap substitute for this fence for 00-Gauge can be had by buying some dozens of Britains farm hurdles, cutting these in two and soldering pins as shown. These can easily be pushed into a pulpwood baseboard if such is used. Wire fencing is easier to make than stripwood. Posts are pierced through a metal jig and forced into the baseboard, heavy cotton then being slotted with a

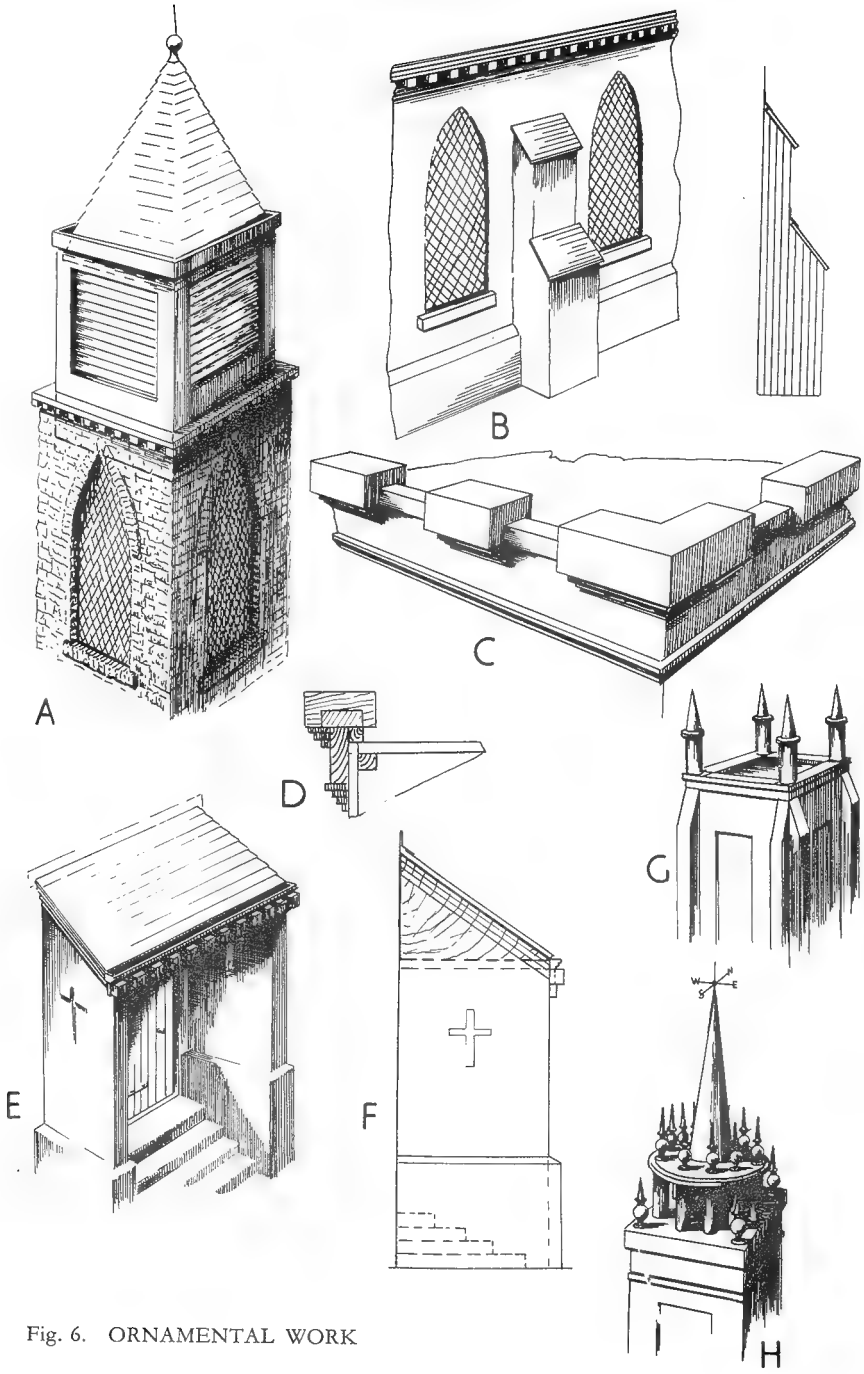


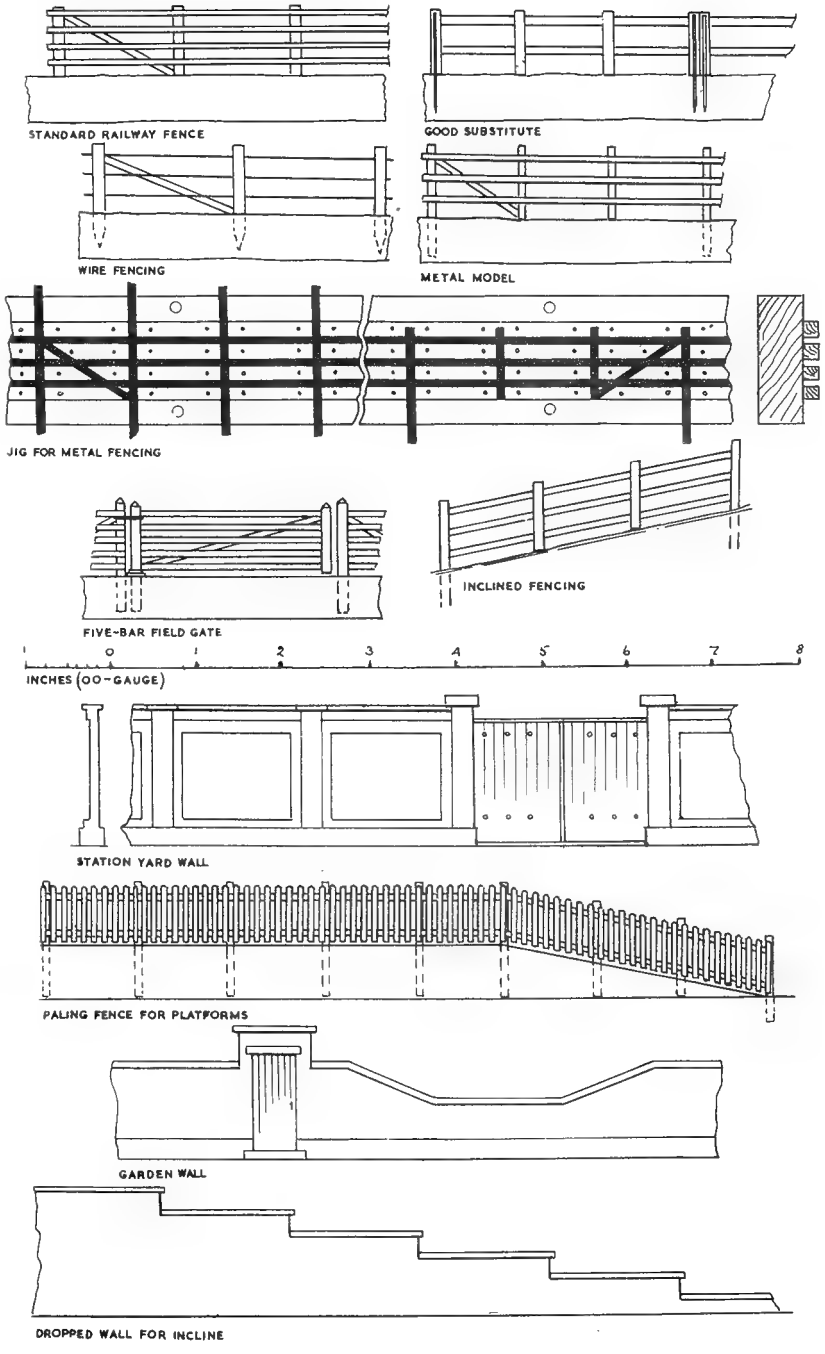
Fig. 6. ORNAMENTAL WORK

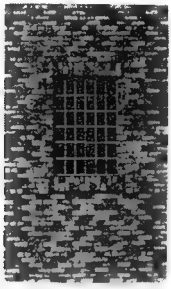
fine needle through the holes. But the best of all railway fencing on a layout is made in metal, using the old type of radio busbar and a wooden jig as described in the diagram. The method is much the same as that of the forming the old metal track. The jig might be made a foot or so in length, and should be provided with holes for screwing down to the bench. Lay in the posts without trimming their length, then tin the rail and touch the joints with a soldering iron. Add whatever corner braces are required—and always include these at every corner—then lift out of the jig, trim off the posts, paint to requirements and set in place. The best of this fence is that it can be lifted and re-located at will. It can also be bent to any horizontal shaping. For a rising location it should be specially formed, and beneath it there should be a board set on its edge below the surface of the terrain. A standard five-barred field gate is also made in the same way.

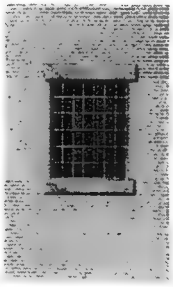
Station models are very rarely provided with any fencing at all, not to mention the correct modern type of brick wall. A diagram has therefore been included for this feature. It can be made from wood in the same manner as the garden wall, but will require more detail work. The correct commercial slatted platform fencing is still to come, but can be fashioned in thin white card by the patient and fastidious. The secret of the work is good glue and little of it. The trimming of the slats should be left till the fence is made, and remember—thin slats, and more slats than spacing. Dry the work under pressure if possible. A garden wall in brick, with a door and a dropped section to facilitate a window-view, is also shown, as well as a wall in brick, with a parapet, for an inclined roadway.

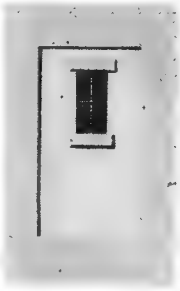
Speaking of brick walls suggests the use of brick-papers, and some adaptations of such papers are given in Fig. 8. A plain window effect in old brick would be used on a factory or service building about a locomotive or goods yard. New red brick is suited to work supposed to be recent. Good effects can be had in panelling around windows and on walls ; an inset eave-window is shown also. A simple style for locomotive and coach shed windows is given. Villa doors can be treated in an endless variety of styles, and the papers are extremely handy in modelling hot-houses, which make the most attractive features. In this instance, the lower frame of the house is made in $\frac{1}{2}$-in. square stripwood, the celluloid sashing being then glued on for walls and the whole bound in place with the paper which also laps over the base. A door is stuck on the gable end, the roof, with corner and cornice strips added, and the thing is done. If interior work is desired, this should be executed before the roof is added.

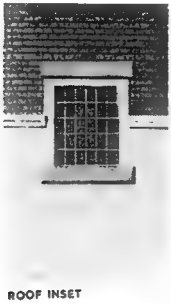
Fig. 7. FENCES AND WALLS

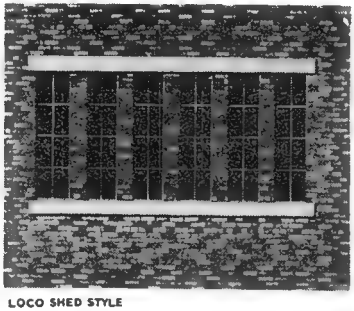


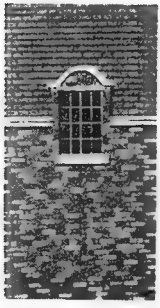

OLD BRICK

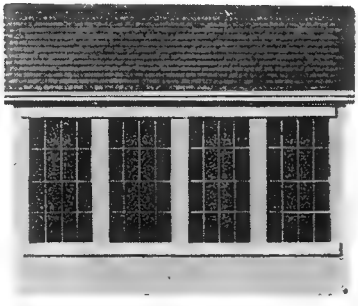

NEW BRICK

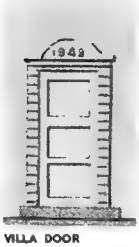

BRICK WITH STUCCO PANEL


ROOF INSET


LOCO SHED STYLE


ORNAMENTAL ROOF INSET


SIGNAL CABIN STYLE



VILLA DOOR

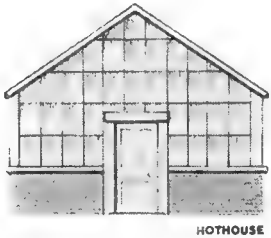
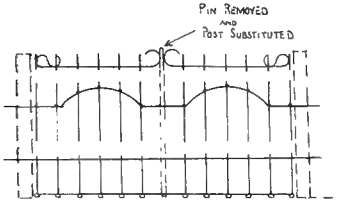

HOTHOUSE

Fig. 8. BUILDING PAPERS

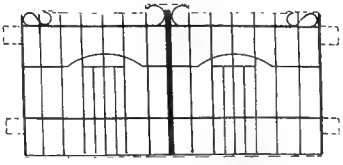
A considerable portion of architectural details will require to be done in metal. For much of this, there is nothing that I know better than the old method which I advocated years ago of using household pins in their papers. Thus in Fig. 9 we have in the first diagram a pair of iron gates. The gaps in the uprights indicate the tags of the papers overlapping and holding the pins, the heads being at the base. First solder a length of fine wire (not too fine) across the pins. Next take another piece, shape it with arcs as indicated and solder it. Leave extensions at the ends for the hinges. Now your length across the top, first forming the curved ends. Lastly, an upright heavier piece for the centre posts. Now remove the paper, trim the gate, paint and fix.

Another method of representing metalwork as for a pair of gates is to draw the work on celluloid, leaving stout celluloid tabs for attaching to the posts. If carefully done, the celluloid becomes invisible when the gate is erected. Other forms of pin-work are shown in the telegraph pole with tiny beads for insulators, the grid, consisting of a length of 00-Gauge running rail sweated in place, which can be used at various places like water standpipe sites, etc. The ship's shrouds are also thus formed. In soldering up a cross for a church steeple, lay the upright on a piece of card, and sweat the two extensions at one operation, not trimming their length until afterwards. Much metalwork can also be done in 0-Gauge ladder for 00-Gauge use, especially if American freight-car ladder is used. This comes with its side rails bent over at a right angle. For a gate, it is flattened out and has braces soldered on. For a light lattice on a foot-bridge, let us say, the rail at one side is left at an angle and the brace soldered in, or fine netting soldered on. Trolley poles are easily worked up in wire, with small-bore tubing for a base. Wire rings of uniform size can be had commercially for this use. A good platform awning support can be fashioned from rail or flat section strip, using these rings, with metal laundry studs, drilled, for bases. Downspouts are best made from wire, and a small nut, filed on one side, makes a good spout-head.

The use of corrugated iron on model buildings can be very attractive. This material can be had to scale for all gauges, and the American firm known as Tru-Scale retail some excellent outfits consisting of large sheets of this material. I give a number of sketches (Fig. 10) which emanate from this firm, and which show the structure of various frameworks and details of this work. A is the plain stripwood framework of a house or other building. B is the skeleton of a saw-tooth factory building; C shows the fitting of a cardboard frame over a window. D gives the

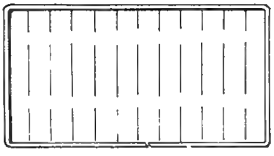


ORNAMENTAL FENCES WITH PINS IN PAPERS

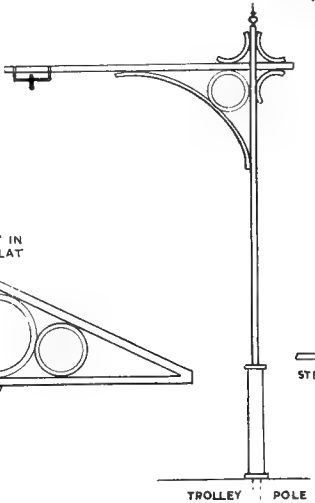


GATES DRAWN ON CELLULOID

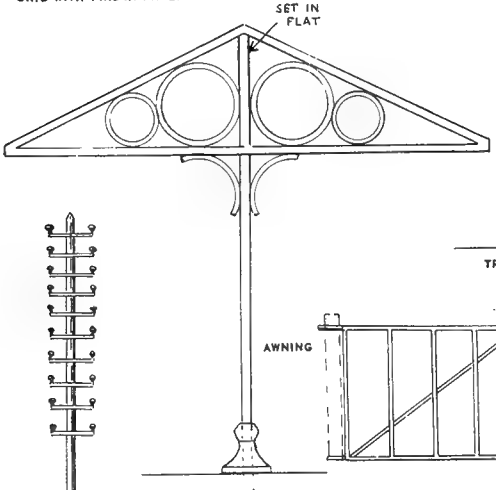
SHIPS' SHROUDS

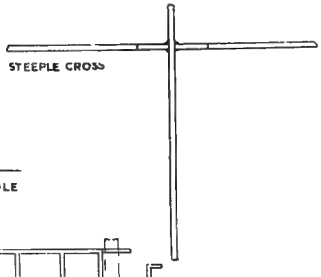


GRID WITH PINS IN PAPERS



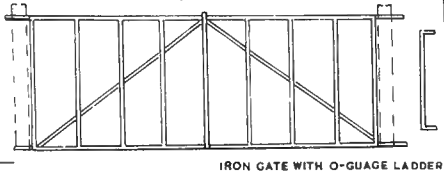
TROLLEY POLE





STEEPLE CROSS

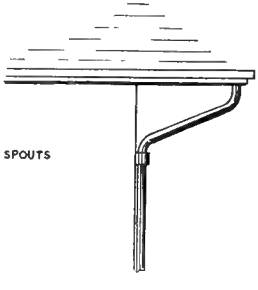
AWNING

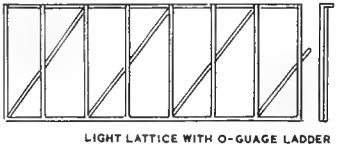


IRON GATE WITH O-GUAGE LADDER

TELEGRAPH POLE

DOWN SPOUTS





LIGHT LATTICE WITH O-GUAGE LADDER

Fig. 9.
METALWORK

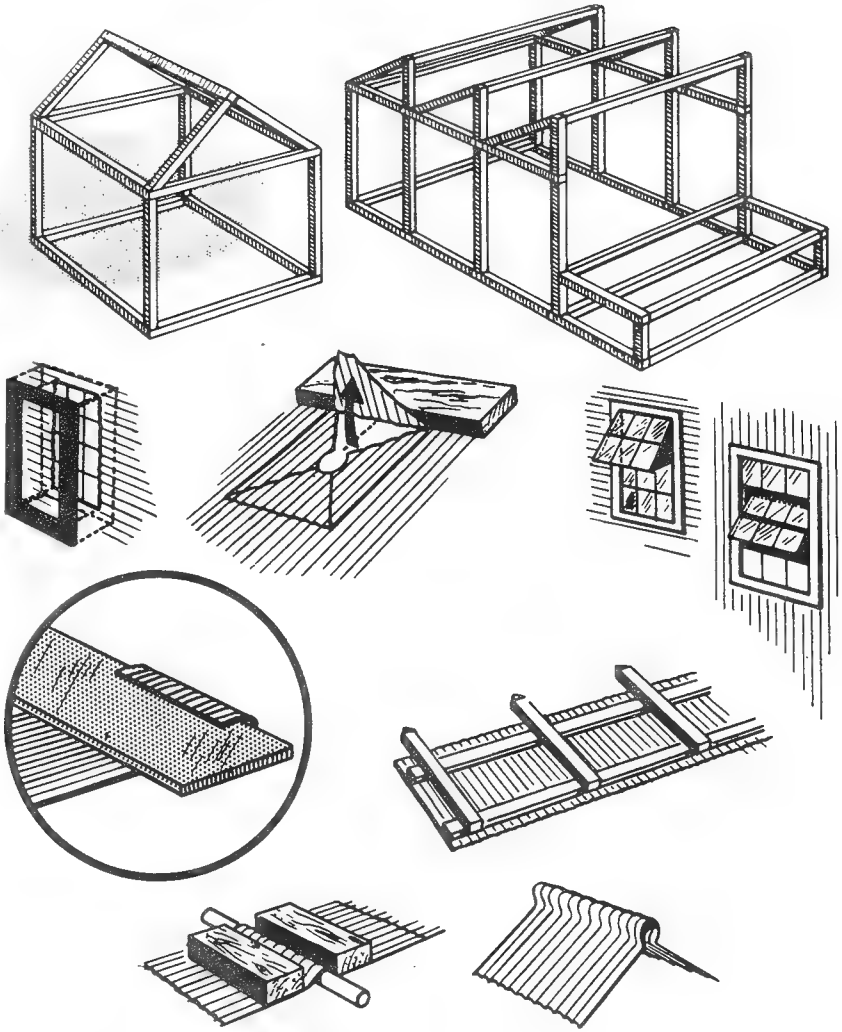
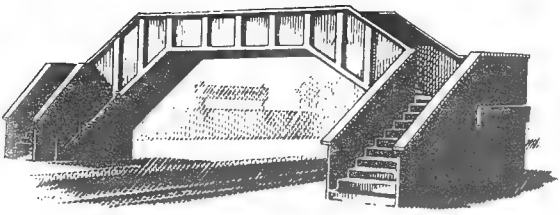
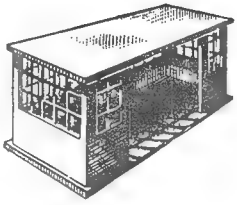
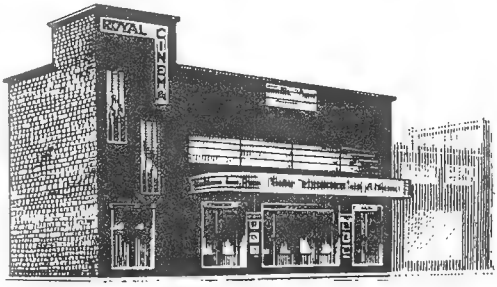


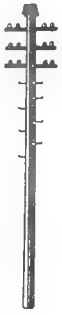
Fig. 10. CORRUGATED IRON WORKING

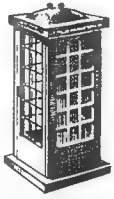
method for making window apertures with a razor-knife in the corrugated metal supplied. In E we have suggestions for open windows. The method of forming a sharp bend is shown in F; the formation of a wall in G, and the making of a roof ridge in H.











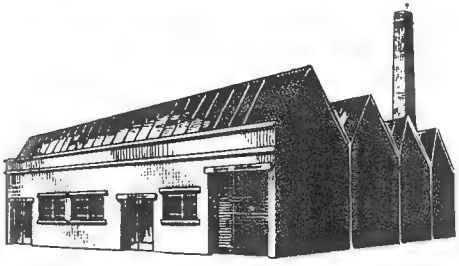
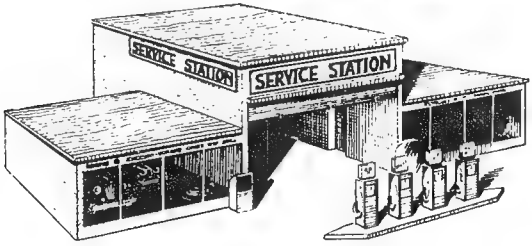
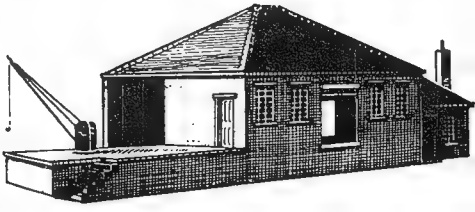


Fig. 11.
TYPICAL
" ANORMA "
DESIGNS





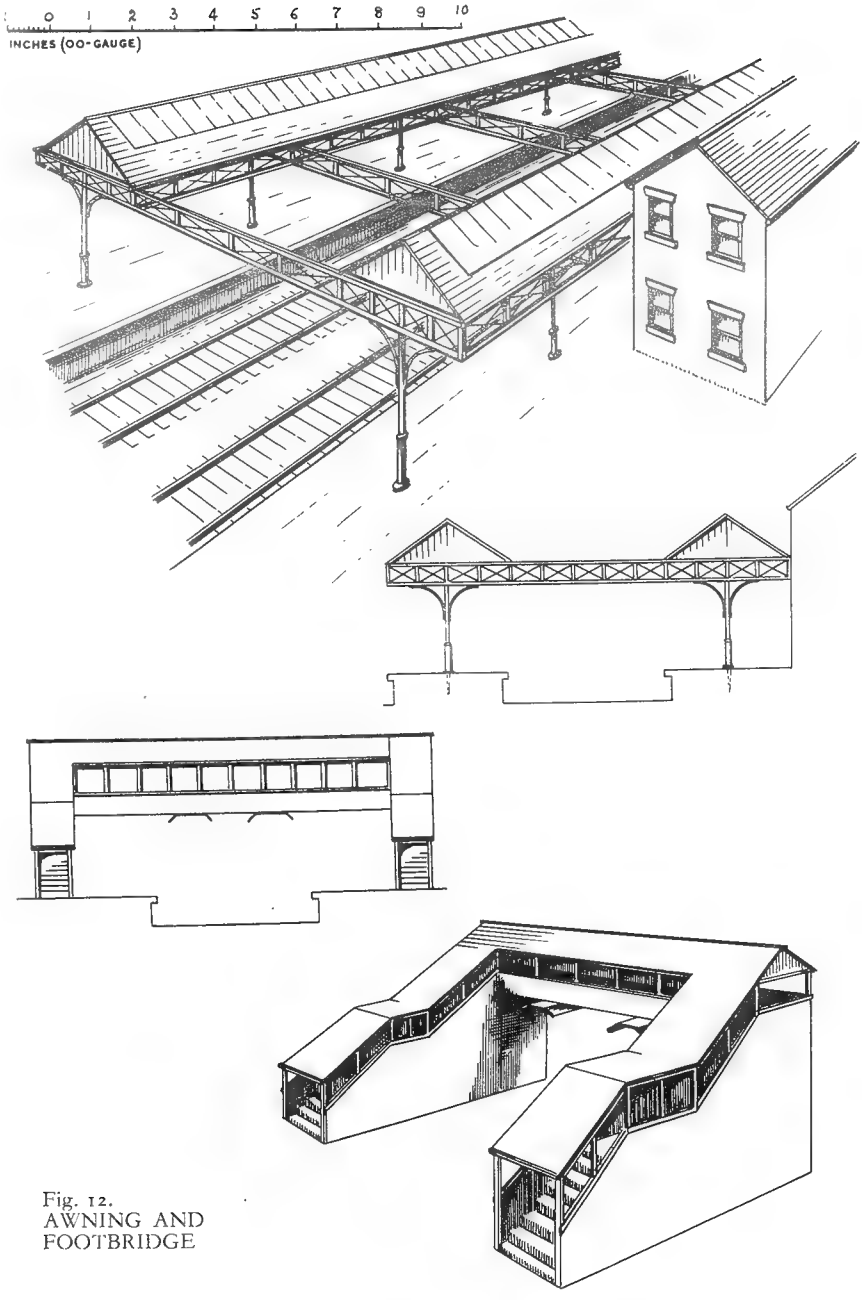


Fig. 12.
AWNING AND
FOOTBRIDGE

The kits known as Anorma are representative of excellent work, and a selection of these is shown in Fig. 11. There is also a photo of a country inn by this firm which will give an idea of the finished work.

Before concluding this section of details I have given in Fig. 12 the soundest way I know of forming platform awnings at a passenger station which will stand the racket of continuous service, and the easiest form of building a covered footbridge. In the latter work, of course, the ticklish task is that of the roof, and the style given demands the minimum of skill. The girders for the awnings can be soldered up in a very simple jig, to form a rigid and realistic framework which can be permanently fixed so that the actual roofs will readily lift off.

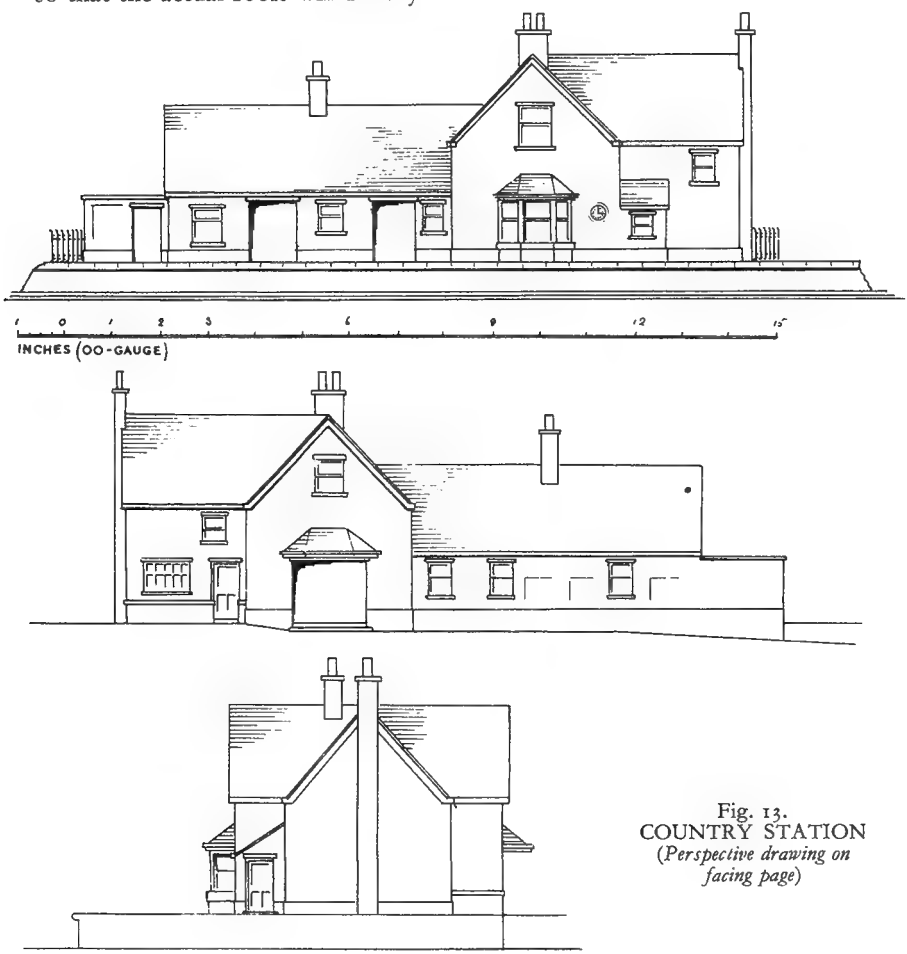


Fig. 13.
COUNTRY STATION
(*Perspective drawing on facing page*)

STATION BUILDINGS

Having thus disposed of a few elementary items of model architecture, we must push forward to the consideration of some standard types of the various railway buildings. We will first consider passenger stations. Of these I have given a number of designs, selecting mainly certain examples which have already been modelled or which are liable to prove essential on the average layout. In Fig. 13 the type is that of the small country station which is shown in the sketch in its full environment of track, highways and approaches. There are few difficulties attaching to the design, roofwork being fairly simple. It should be stated that passenger and goods platforms are, in the smaller scales, best when modelled in the solid; and as this happens to be the simplest way, that is all to the good. My own practice is to have them cut by a local joiner, who is equipped with the necessary tools for planing all the surfaces. Have a cardboard template cut if necessary, and mark the dimensions of the ramps. For 00-Gauge the thickness of the wood should be $\frac{5}{8}$ in., with ramps 3 ins. in length. When these are finished, cover the edges

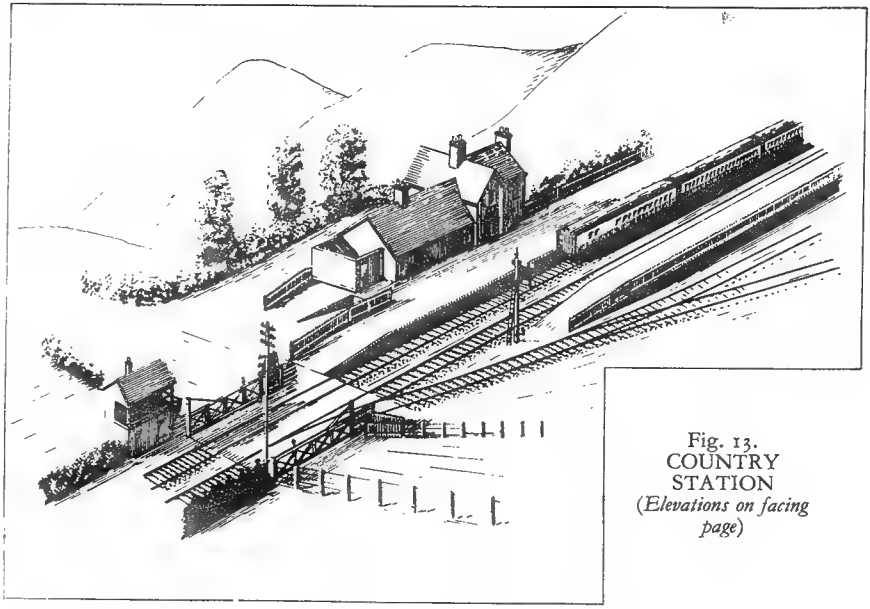


Fig. 13.
COUNTRY
STATION
(*Elevations on facing page*)

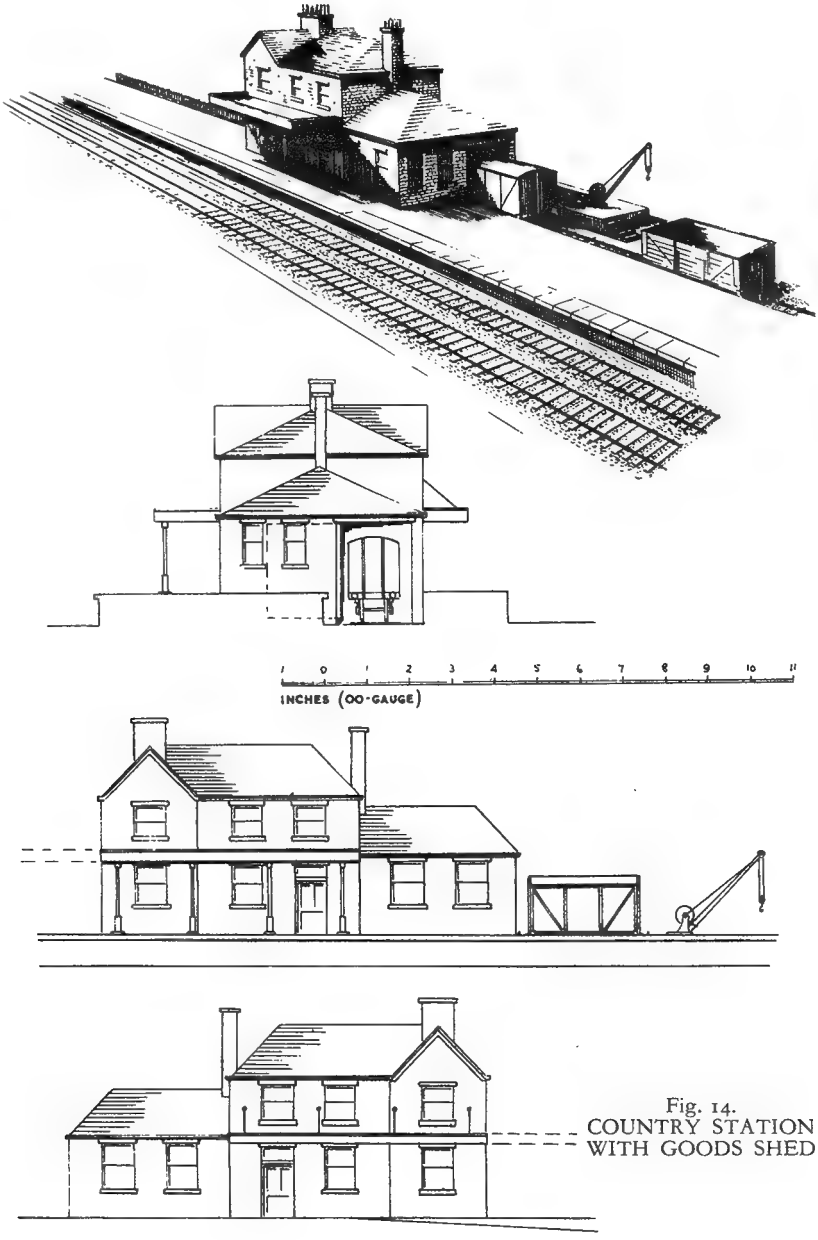


Fig. 14.
COUNTRY STATION
WITH GOODS SHED

with brick-paper of a weathered style and pin and glue along the edges that will face the trains a strip of $\frac{1}{8}$-in. stripwood, tapering this down at the ramp. Cover the surface of the platform with very fine emery or other imitation ashphalt paper, and then glue a strip of adhesive tape along the train-edges, right out to the edge of the stripwood. This should be painted for concrete, along with the stripwood edge. This will give you an excellent and solid structure which can be screwed to the baseboard from underneath. In screwing it down you will require pressure from the upper side. Failing all else, use a heavy weight or large rock.

The design in Fig. 13 is without freight facilities, which would require to be independent of the main buildings. But in the next design (Fig. 14) there is an example of the typical country station with goods shed as an integral part of the main building. In Fig. 15 we have something more elaborate and original—a station comprising two levels which cross each other at right angles. Of course, the angle of the crossing may be optional, so long as it is allowed for in the planning of the buildings. The design includes an essential double-span plate girder bridge, and fuller details of this structure, as well as of the buildings, are given in Fig. 16. The stairways to the upper level are concealed underneath one of these bridges, and the bridges, it will be observed, also carry the upper platforms.

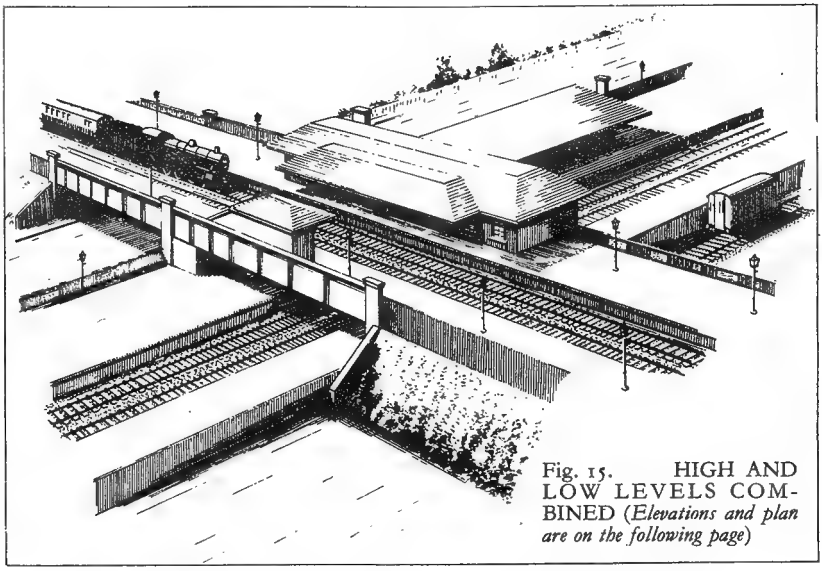
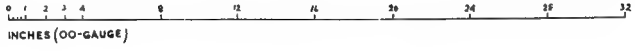
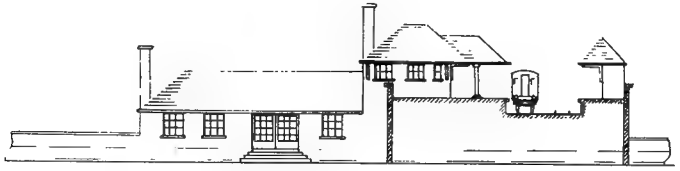
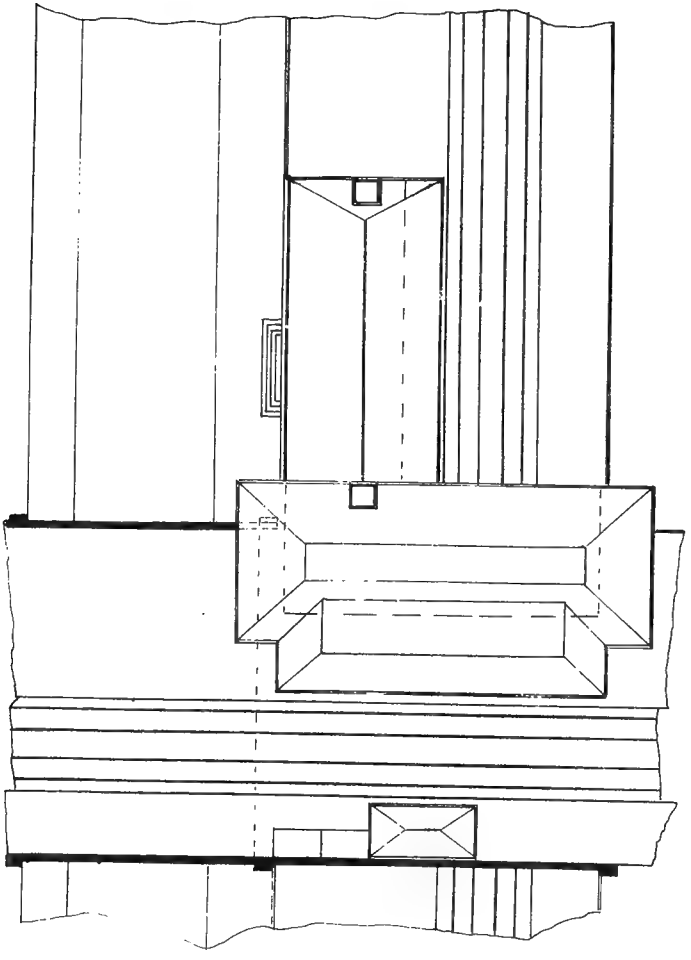
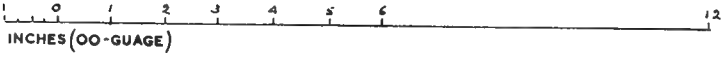


Fig. 15. HIGH AND LOW LEVELS COMBINED (*Elevations and plan are on the following page*)








0
1
2
3
4
5
6
12
INCHES (00-GUAGE)

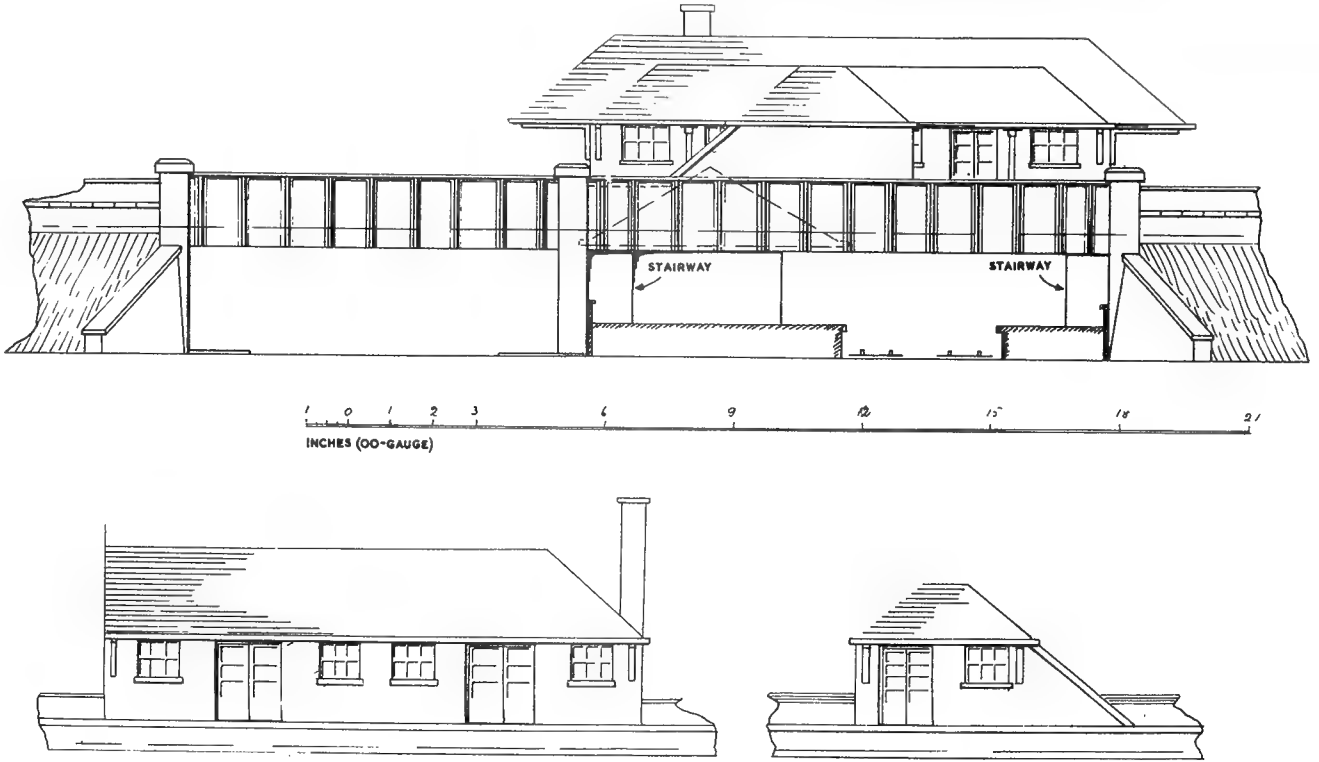
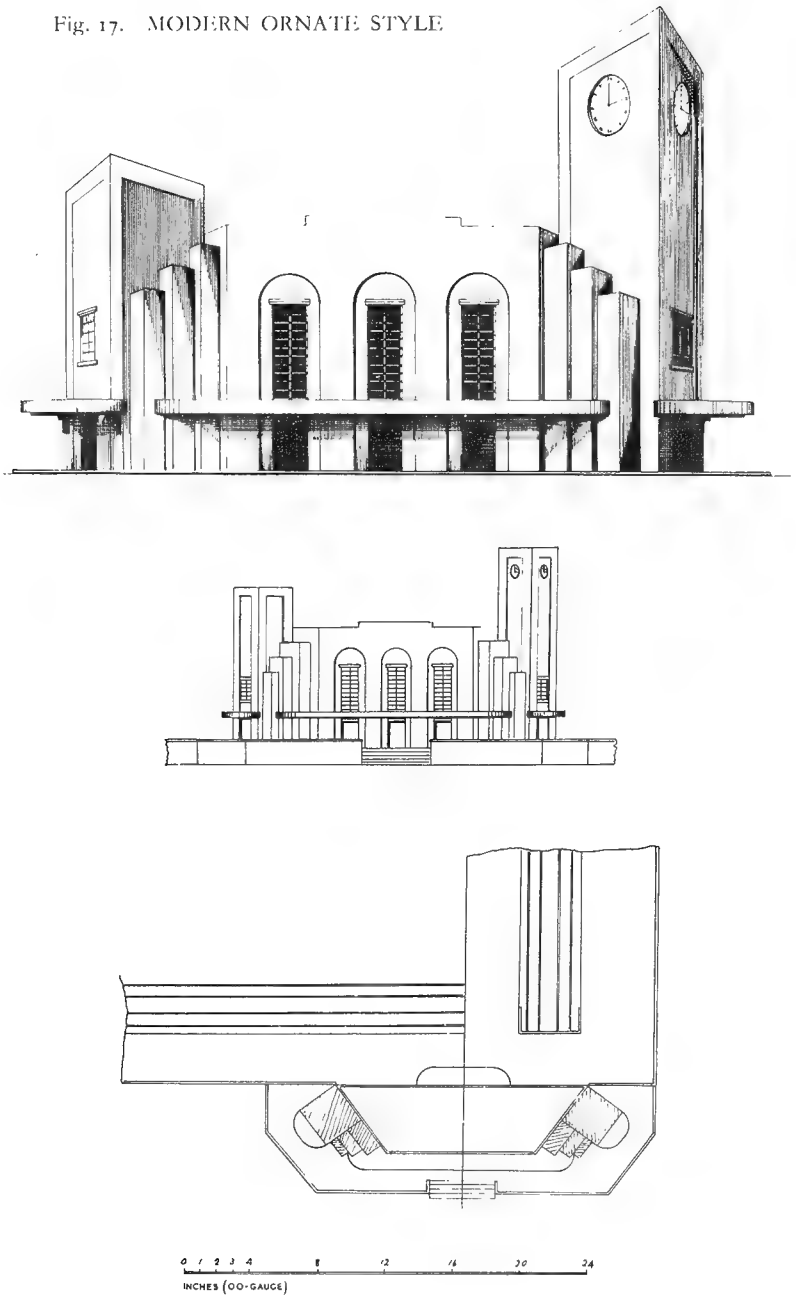


Fig. 16. COMBINED LEVELS

Fig. 17. MODERN ORNATE STYLE



The modern ornate style of station edifice is shown in Fig. 17, this being a reproduction of the newest station on the West Midland Lines owned by the writer. In construction, both the towers and the cubist columns are modelled from solid, planed blocks of wood, which in the case of the towers is faced up with cardboard in order to provide for inset windows. The front facade of the concourse is formed from a double thickness of material to provide the arches. The canopies are of solid wood with a cardboard facing strip, and are suitably curved in shape. The building can be treated either as stucco, red- and yellow-brick or any other suitable way. In the West Midland model the piers and tower projections are merely represented by shade-lines, which are entirely effective. The roof is covered with black adhesive tape. The advantage of this design is that it can be used for either a through or a stub type of station, as indicated in the plan. The style of it leaves nothing to be desired in the way of beauty.

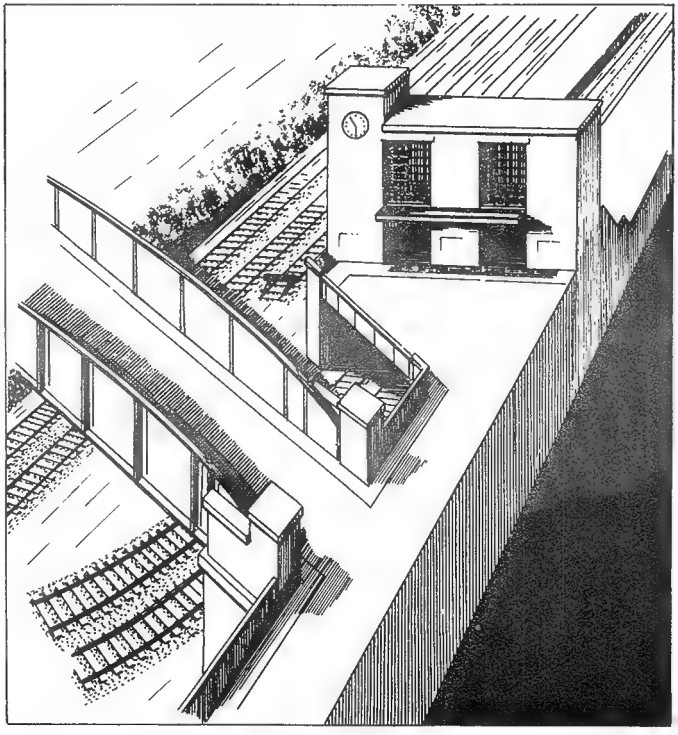


Fig. 18. DESIGN FOR AN AWKWARD LOCATION
(*The plan and elevations are on the following page*)

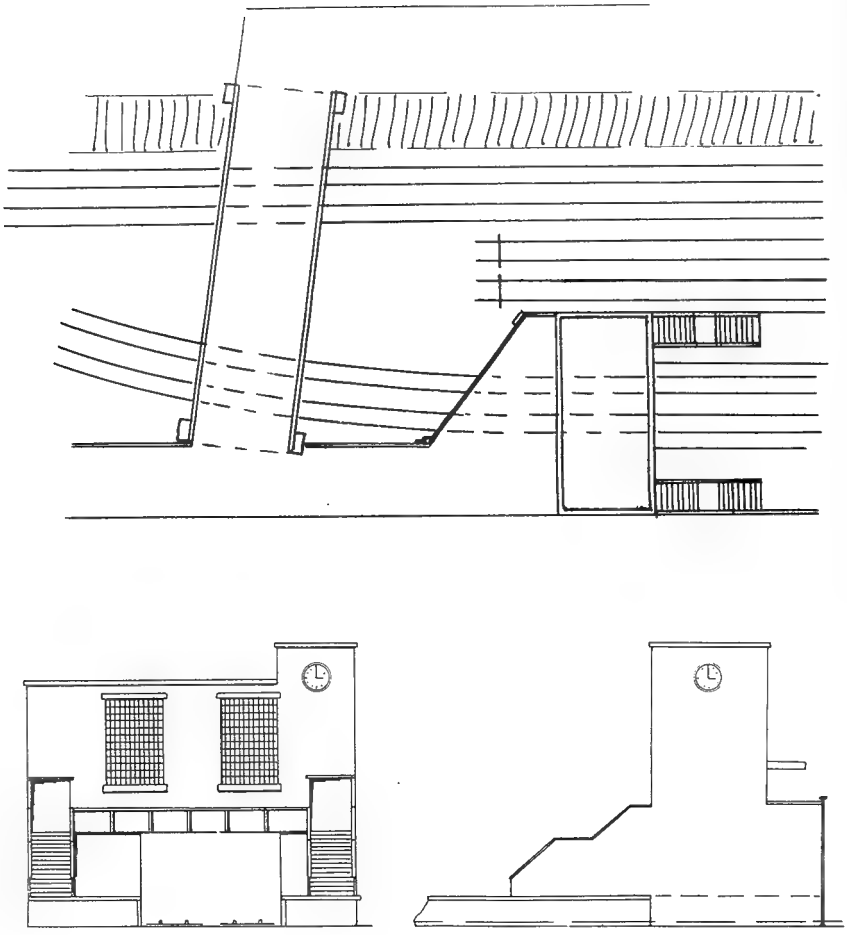


Fig. 18. DESIGN FOR AN AWKWARD LOCATION
(The perspective drawing for this is on the preceding page)

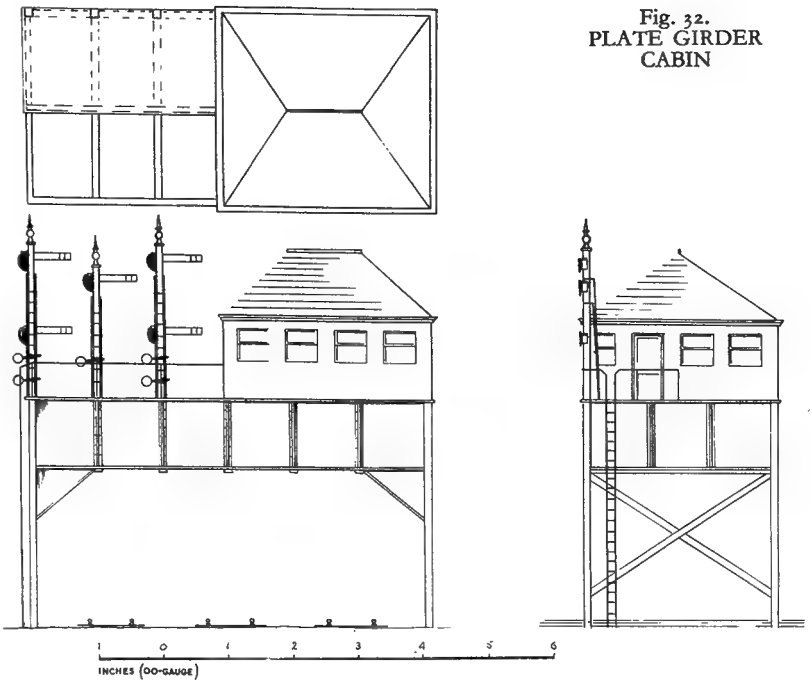


Fig. 32.
PLATE GIRDER
CABIN

well as the standard signal ladder employed. In Fig. 32 will be found a dimensioned design for the plate-girder box, which includes a gantry of signals.

Several photographs of signal cabins modelled in 00-Gauge by the writer and his friends will serve to give a wider cover to this range. The tiny Highland model was built entirely of wood, and was designed from an original prototype. The stucco cabin was built from an old design by the writer by members of a London Club, and is an excellent piece of work. The standard modern brick cabin is well-known on the old L.M.S. lines, and the large brick building is in service on the new West Midland Railway. The brick cabin by Model Structures (0-Gauge) represents American practice, but is very close in its style to modern British procedure.

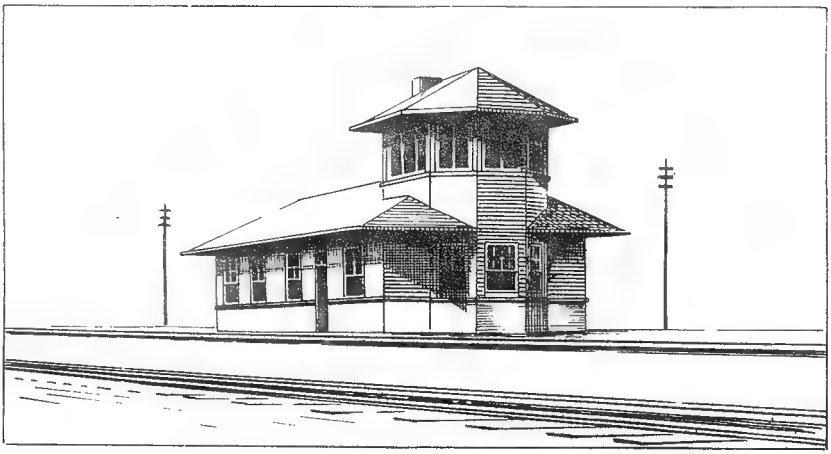


Fig. 19. ISLAND BUILDING WITH CABIN
(*The plan and elevations for this are on the preceding page*)

It occasionally happens that station buildings become necessary at very awkward locations, and in Fig. 18 there is a design which was adopted on an earlier layout by the writer. Here, a double-track through road required a right of way past the station, and there was no possible means of road-access except by way of a probable overbridge. A plain modern brickwork style was chosen, and the highway access was made on the upper level.

For an island station with limited space the design of Fig. 19 is attractive, and will give scope for a little roofing skill. A good width of platform is demanded.

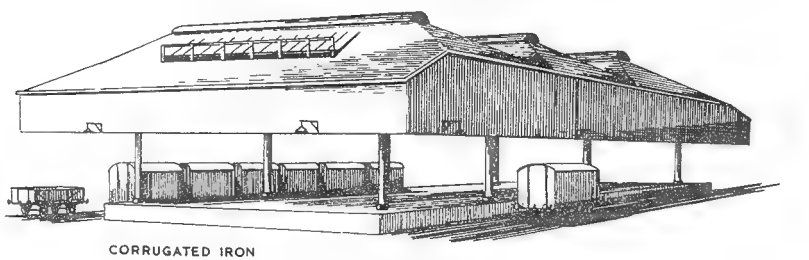
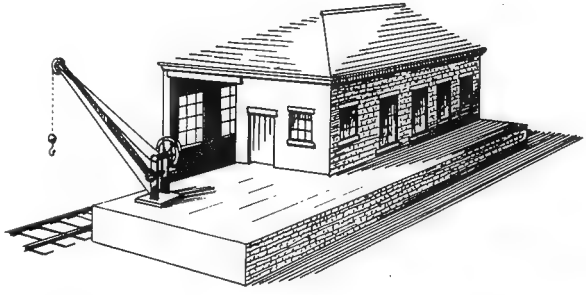


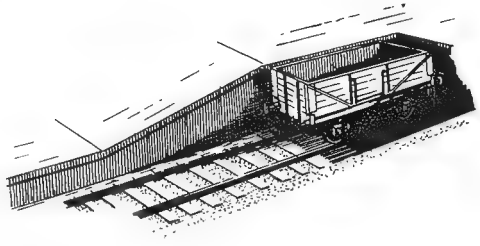
Fig. 20. TYPICAL GOODS SHEDS
(*Other drawings in this figure are on the facing and following pages*)

GOODS YARD BUILDINGS

During the past 20 years I have produced fully 30 designs for freight sheds and depots, yet the range is quite inexhaustible. In Fig. 20 there will be found sketches of five varied types. One of these is the large corrugated iron structure with open sides, which I have never seen modelled, but which would form a fine prototype. I propose therefore to select this one for more detailed attentions. Other types speak for themselves, and the top-edge loading bank is a useful and characteristic feature that is readily modelled. If the builder can secure from Tru-Scale, San Dimas, Ca., a supply of corrugated aluminium he will be equipped with excellent scale material for the purpose. Failing this, much can be done with scribed card. It is not recommended that the sheeting should be left in its natural colour; it will look much more convincing if painted red oxide or dark grey on completion. The semi-circular ridge-ventilators consist simply of half-round wood strip with a thin capping of cardboard. A framework should first be made of stripwood, and the columns can be executed in dowelling. The bases of the columns can be represented by coiling adhesive tape tightly around the dowels. Metal washers are also useful for this work. The building looks large, but it covers a space only 15 ins. by 8 ins.



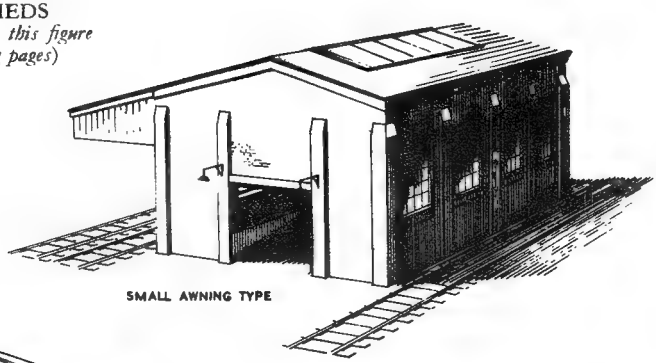
COUNTRY STYLE

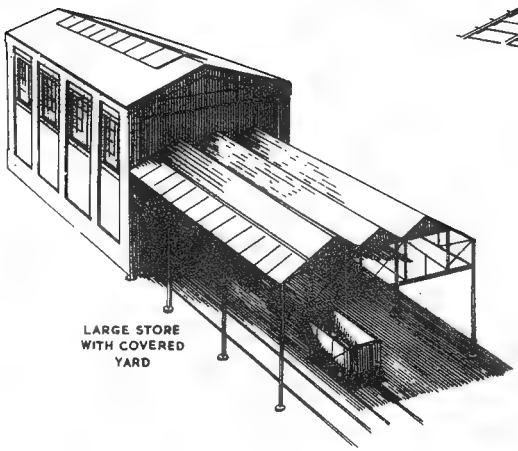


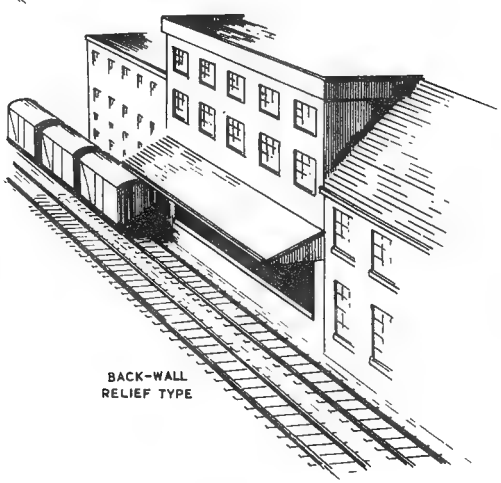
TOP-EDGE LOADING BANK

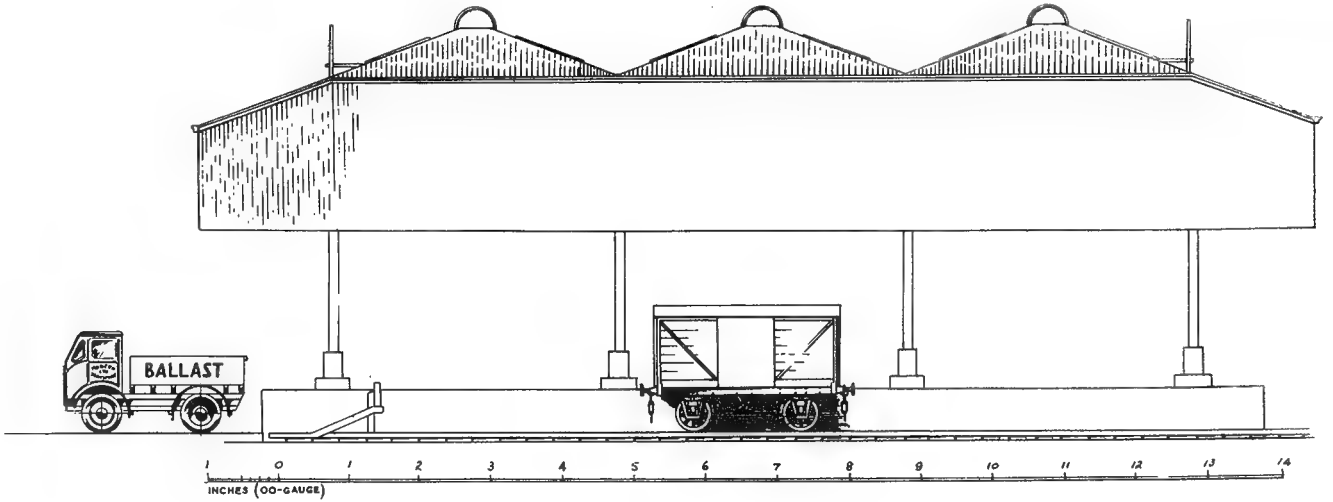
Fig. 20. TYPICAL GOODS SHEDS (*Other drawings in this figure are on the facing and following pages*)

Fig. 20. TYPICAL GOODS SHEDS
(Other drawings in this figure are on preceding pages)









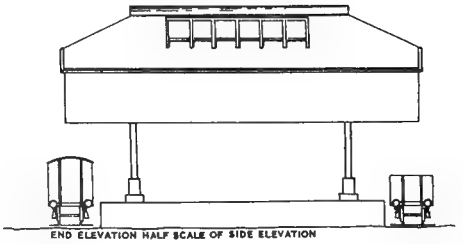


Fig. 21. CORRUGATED IRON GOODS SHED

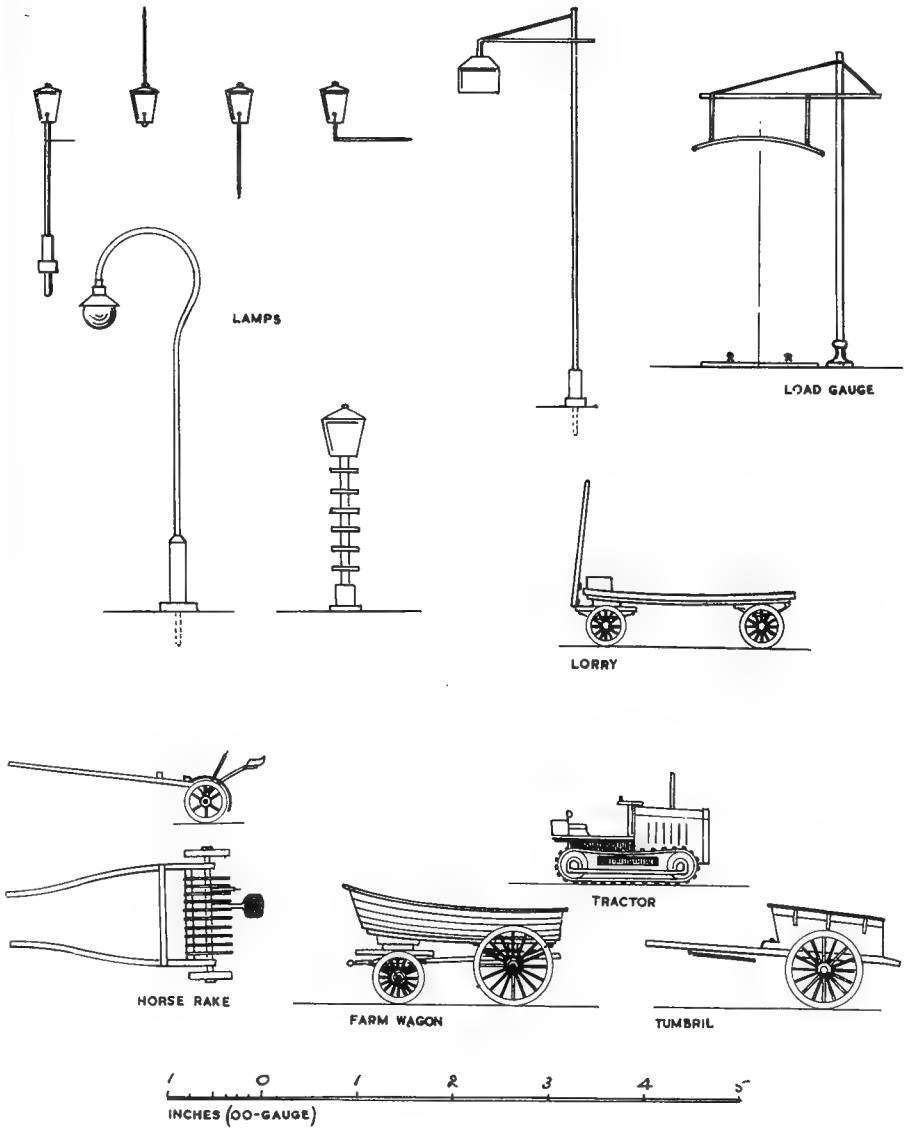


Fig. 22. FOR THE GOODS YARD
(Further drawings for this figure are on the following page)

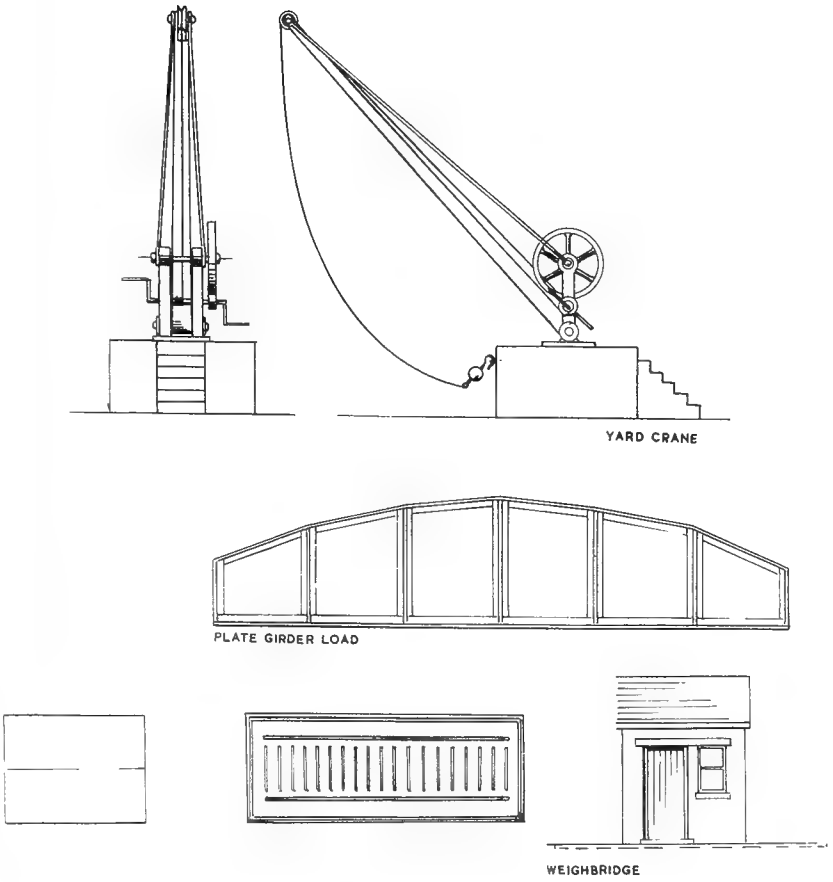


Fig. 22. FOR THE GOODS YARD
(Further drawings for this figure are on the facing page)

In Fig. 22 we have numerous useful gadgets for the furnishing of a goods yard, which may be of course supplemented without limit. Lamps, loading-gauge, hand crane and weigh-bridge belong to the normal equipment of the yard. All the types of yard lamps illustrated may be had commercially from Brightman's of West Hartlepool. The small plate girder and the various vehicles are suitable for wagon loads.

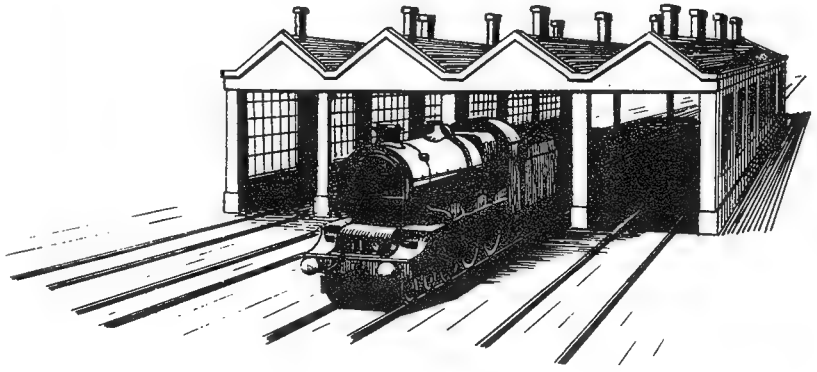
LOCOMOTIVE ACCOMMODATION AND YARDS

A similar series of sketches (Fig. 23) depicts some types for engine-shed construction, all of these representing the straight type of normal British shed. If a roundhouse is the order of the day, a design is given in Figs. 24, 25 and 26. The roundhouse itself is here provided with an adjoining machine shop and power house, and it is worth noting that the whole of this covered space can be used for housing locomotives. So far as the building itself is concerned, there is little that it is necessary to dwell upon at great length. I have included designs for accurate templates which can be cut from card and used to obtain the shapes of the roofs. Stripwood $\frac{3}{8}$-in. square is used for the making of the framework. Smokejacks are formed from dowelling, capped in each instance with a "dome of silence." The effect is quite realistic.

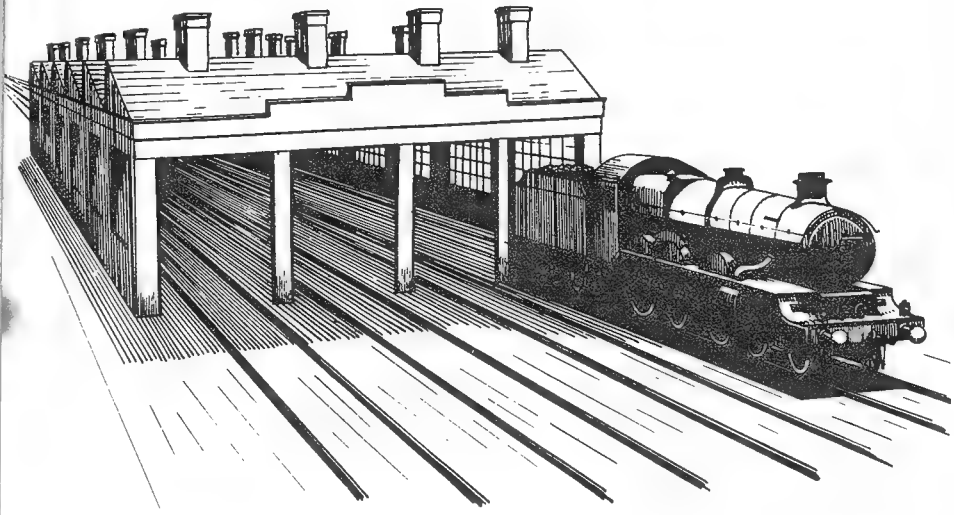
The straight shed is provided for in Fig. 27, and provided with a saw-tooth roof. The more perpendicular sides of the roof sections are glazed and sashed in the manner shown. For this purpose scribed celluloid should be used, and the scribing should be finished with a dark-coloured paint such as red or grey, or even black. The windows are recessed, and there is an ornamental front gable. The projecting smoke-troughs at front and rear should be noted, and in order that the roof-jacks may be uniform in size, I would suggest the use of a certain type of cheap clothes peg for the purpose. These will be found provided with the correctly tapered shape, and one "leg" should be cut away. Old brick or very dirty concrete is the best finish for this type of building. The example given is doorless, as in accordance with modern practice, and the entire building is easily lifted about for access to the engines.

If operating shed doors are desired, these, with other engine-yard items, are shown in Fig. 28. Along with the details of the doors there are included retaining-posts and the arrangements for the flush flooring of the shed. Doors may be of wood, with strip-metal hinges glued on, or of metal, in which case the hinges can be strongly sweated in place. Ventilator roofs are not difficult to model. If it is desired to have the vent-slats showing daylight, proceed as in the upper sketch, using flat card or stripwood with a half-round strip of wood for the projecting top. A very substantial vent-roof can be made wholly from the solid by using anglewood throughout as in the lower sketch. Four additional types of

smokejacks are illustrated in the same figure. One of these is formed from a golf-tee with a curtain pulley pinned at the top; another from dowelling, with a "dome of silence." A third is made in the standard orthodox manner, and a fourth is a ridge-type formed from a pulley, an empty cartridge-case and a long screw.



MODERN DOORLESS STYLE



SAWTOOTH DOORLESS

Fig. 23. LOCOMOTIVE SHED TYPES
(Further drawings in this figure are on the following page)

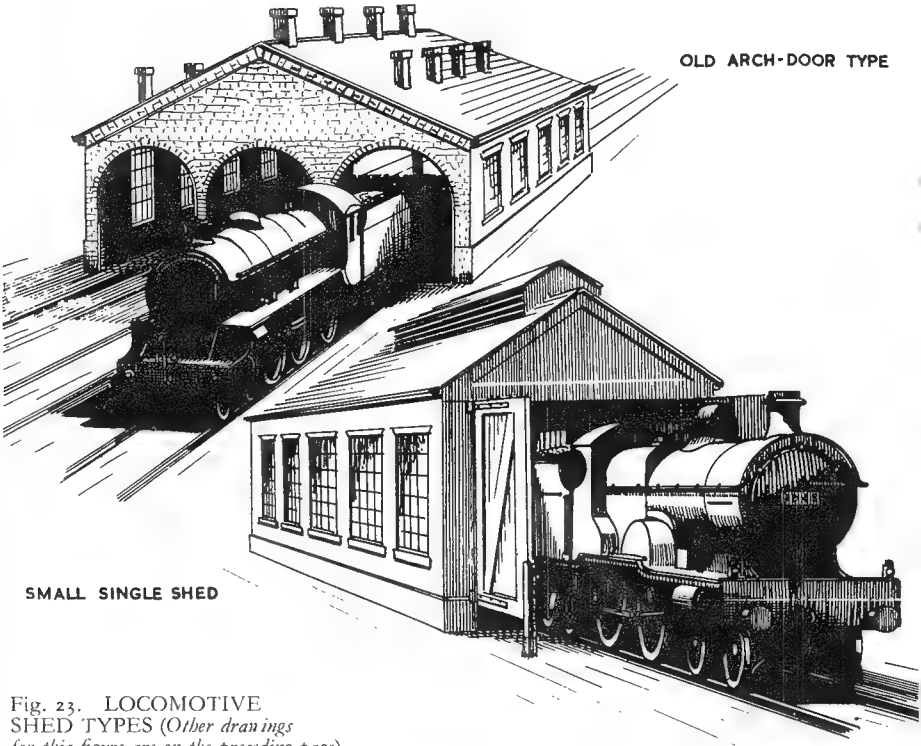


Fig. 23. LOCOMOTIVE SHED TYPES (*Other drawings for this figure are on the preceding page*)

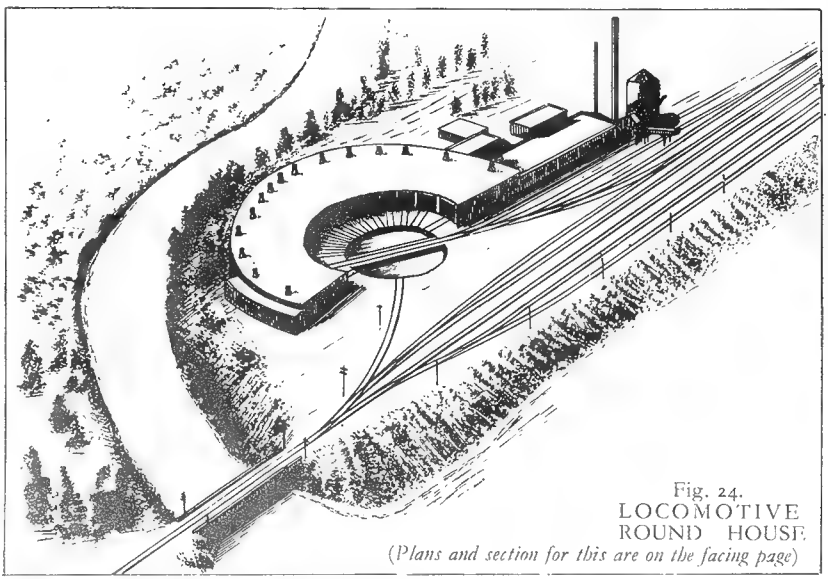
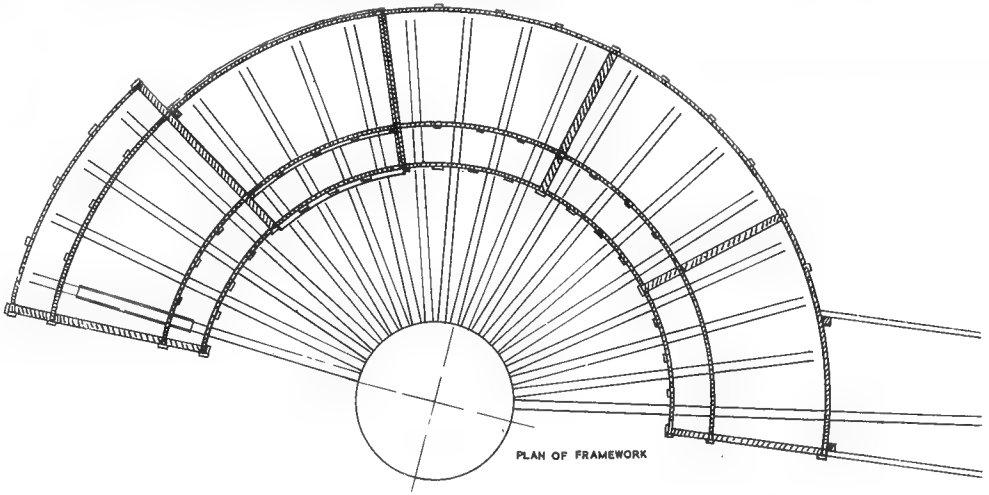
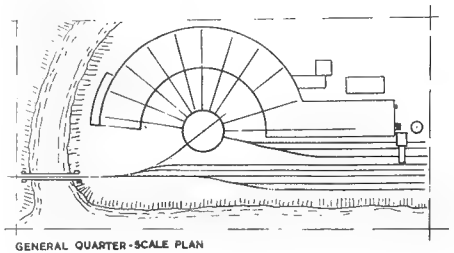
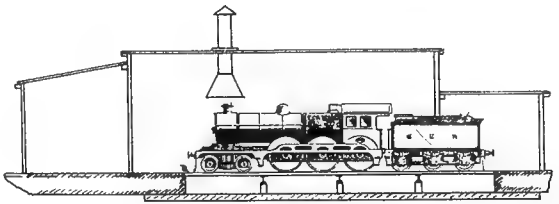


Fig. 24. LOCOMOTIVE ROUND HOUSE
(*Plans and section for this are on the facing page*)

Fig. 24
LOCOMOTIVE
ROUND HOUSE
(The perspective drawing for this is on the facing page)




GENERAL QUARTER-SCALE PLAN


DOUBLE SCALE SIDE SECTION

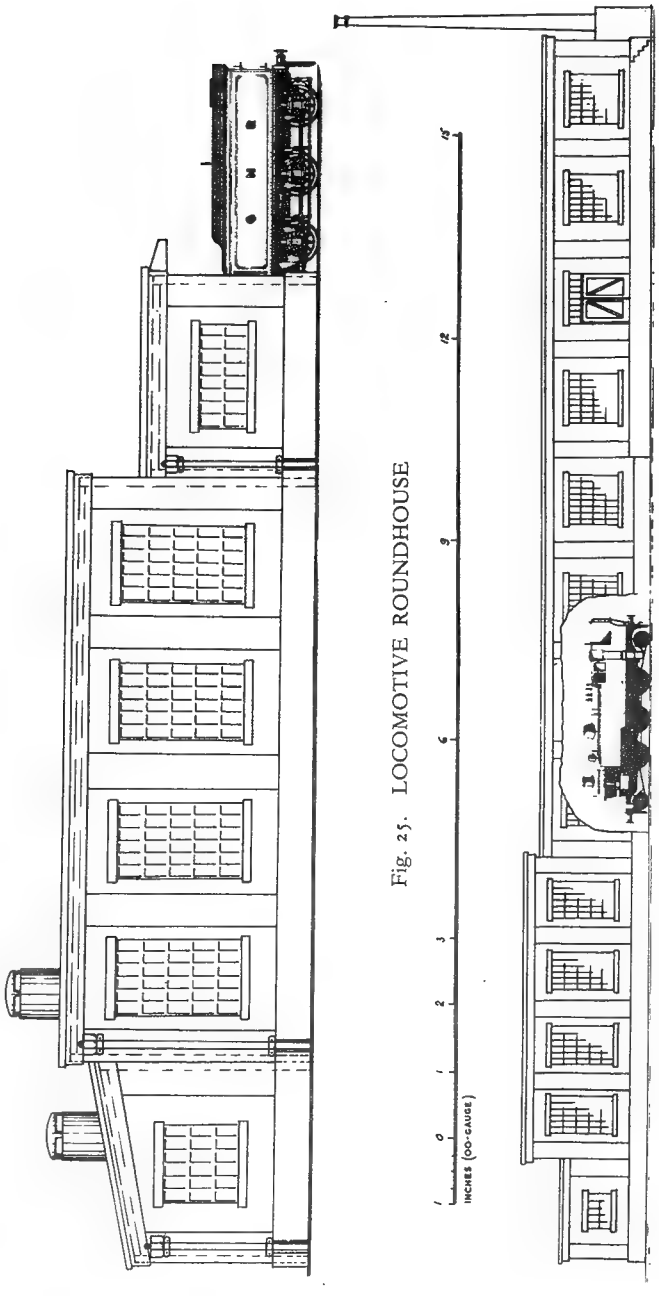


Fig. 25. LOCOMOTIVE ROUNDHOUSE

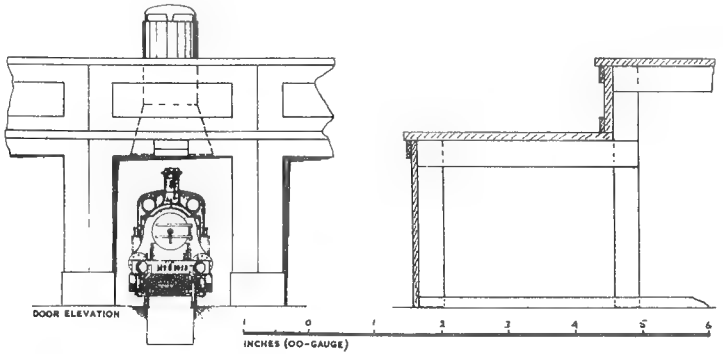
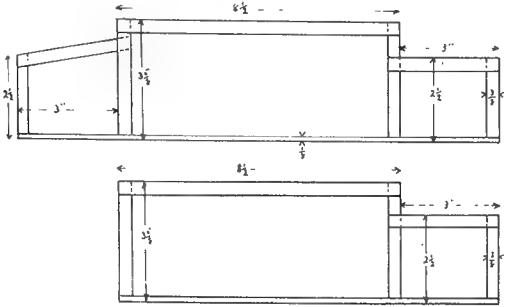
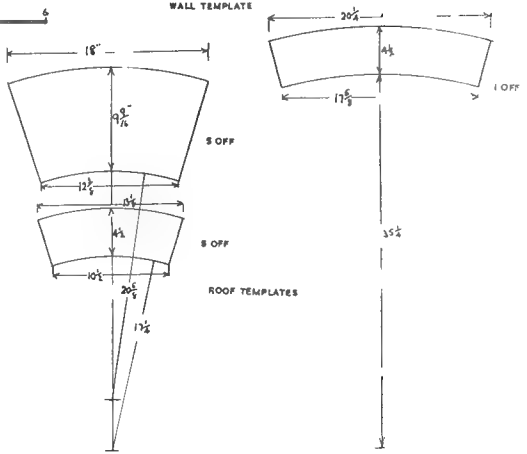


Fig. 26. LOCOMOTIVE ROUNDHOUSE





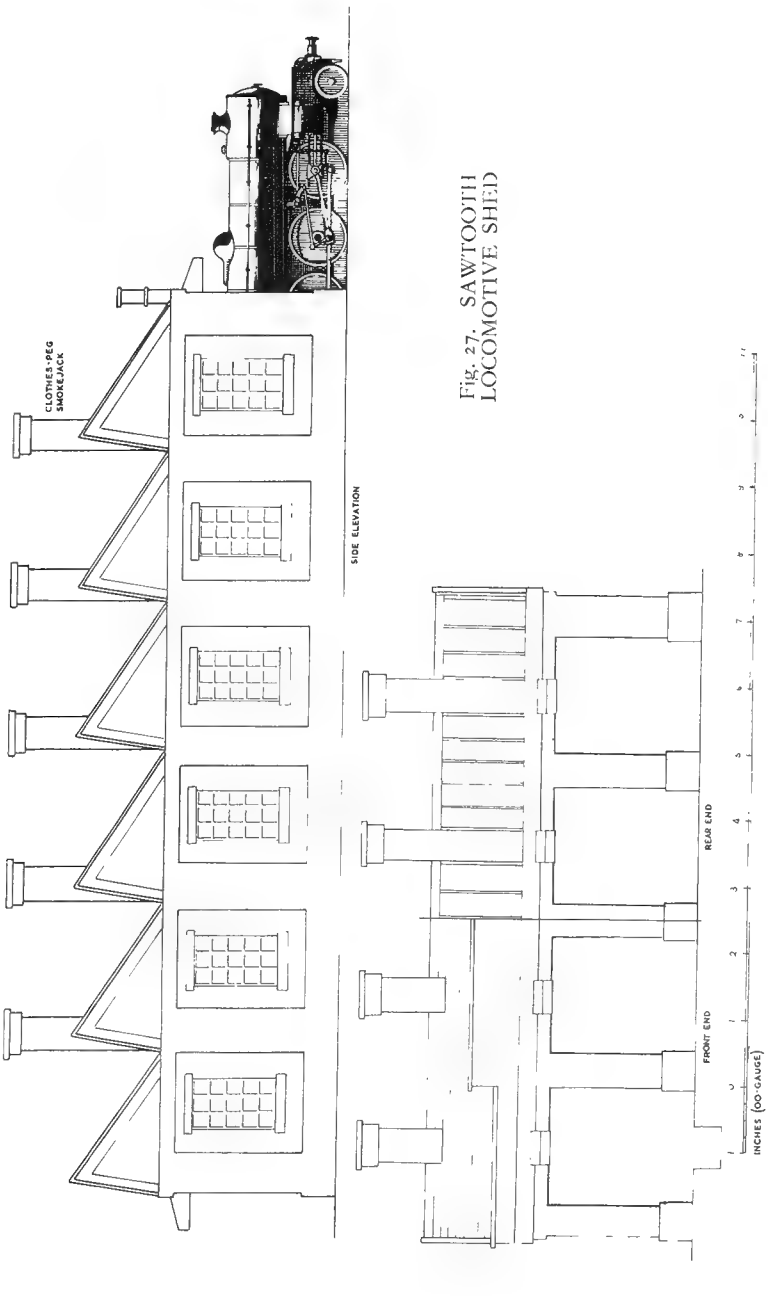


Fig. 27. SAWTOOTH LOCOMOTIVE SHED

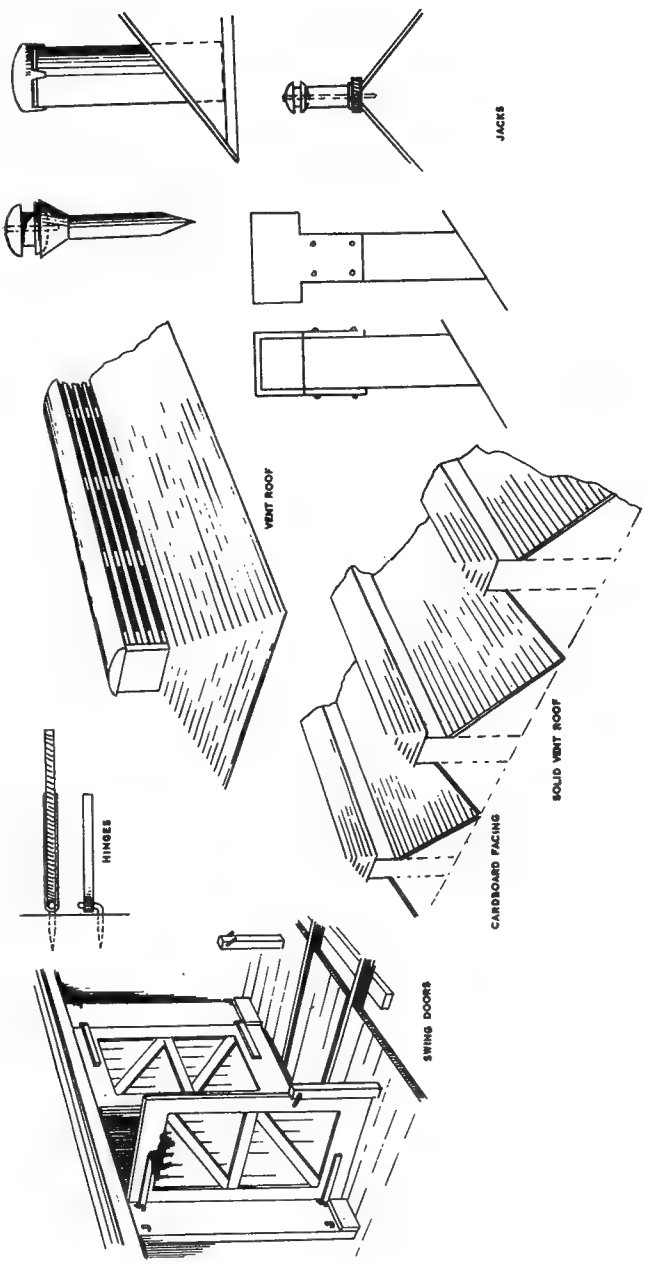
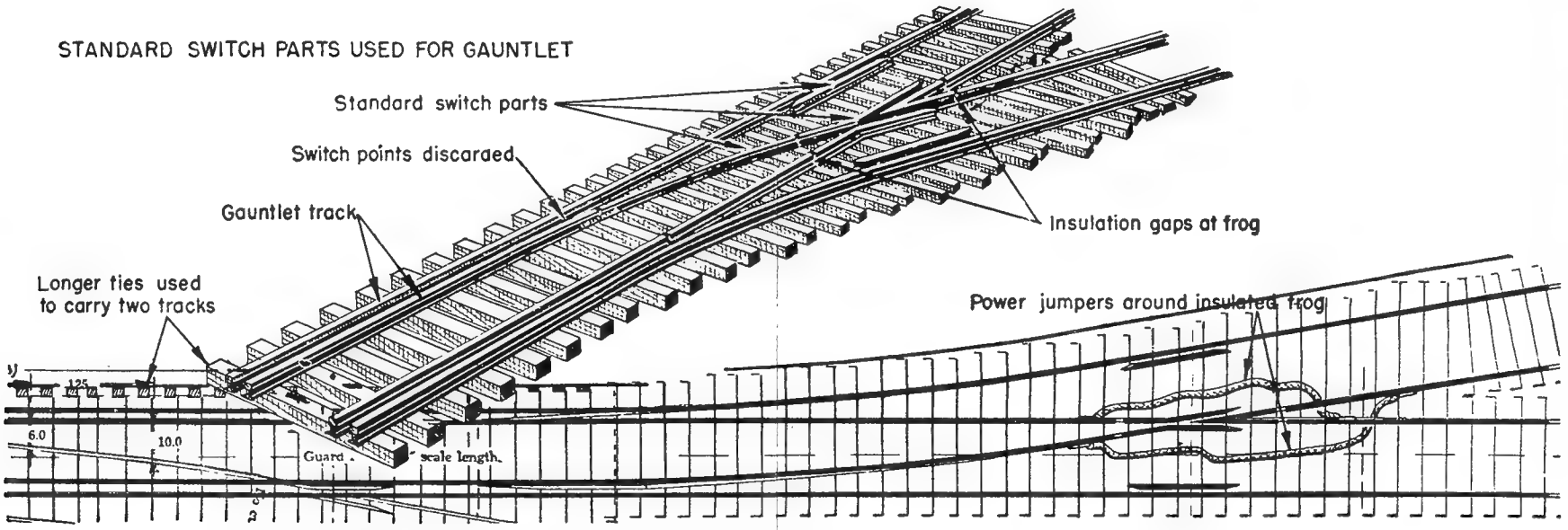


Fig. 28. LOCOMOTIVE SHED DETAILS

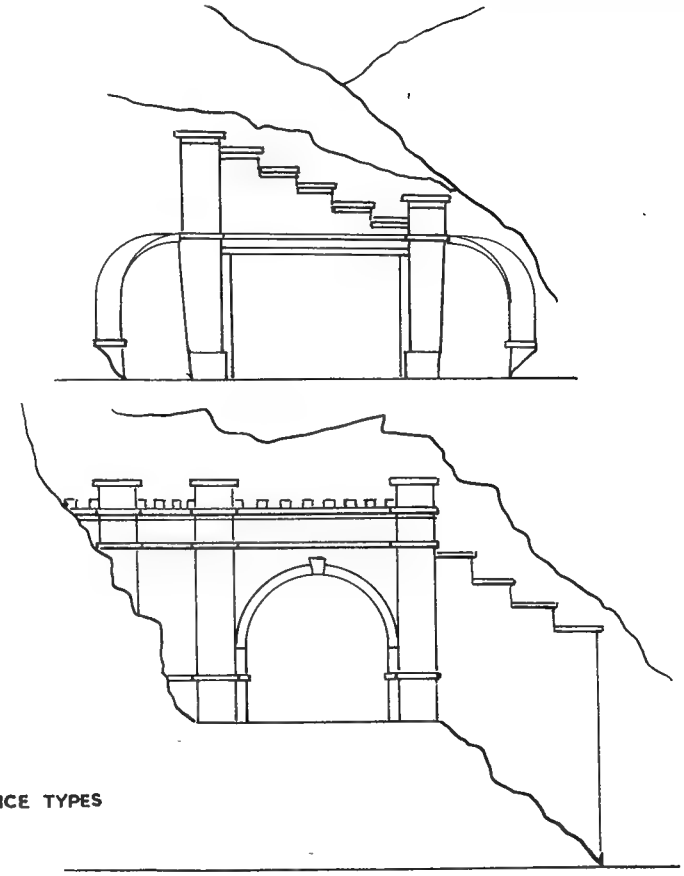
TUNNELS

The engineering side of tunnel work has been fully dealt with already, but one or two details may be noted also at this juncture. Acceptable portal dimensions are given in Fig. 29, and a couple of additional entrance designs are also included. I have found that for the ornamental work along the upper edge of a tunnel mouth, the commercial awning-edging, if inverted, can be used with advantage. One of the designs is provided with a "step-down" buttress at one side to allow for embankment tracks; the other has curved wing-walls. Some aid will be found in the upper left-hand sketch for the formation of the scenic work adjoining a tunnel entrance. It will be seen that a frame is first fitted over the embankment or on the baseboard, as the case may be. To this the tunnel facing is screwed with flat-headed screws. The canvas, linen or other scenic material is then glued and pinned to the rear side of the face. The work is really not nearly so complicated as it appears. Occasionally the baseboard where a tunnel occurs is somewhat restricted in area and there is no space for a pair of standard piers. This happened recently on the West Midland Lines, and the expedient shown in the remaining sketch was followed. Very often, especially in America, a double track requires to pass through a tunnel constructed for single track, or at a place where a double-track tunnel would be too expensive or too restricted. In this instance, gauntleted tracks are employed. That is to say, one track is run inside the other without the introduction of points. For this purpose, it is possible to utilize a couple of standard model points by removing the operating ends of the blades and making the rails fixtures. In the drawing from the *Model Railroader*, on the other side of the inset sheet, this interesting procedure is described. It is not only possible to use the template of a point in this manner, but the point itself can be pressed into service.

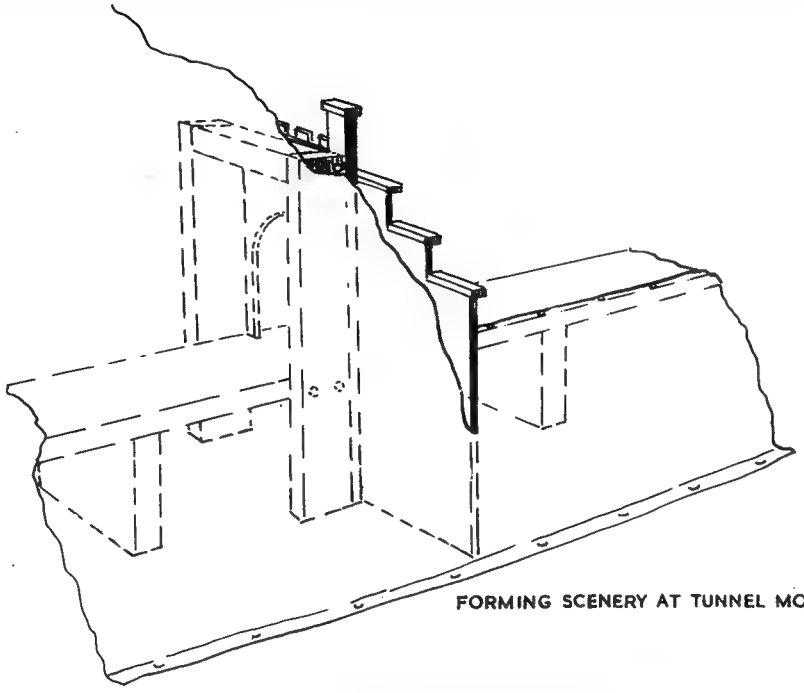
STANDARD SWITCH PARTS USED FOR GAUNTLET



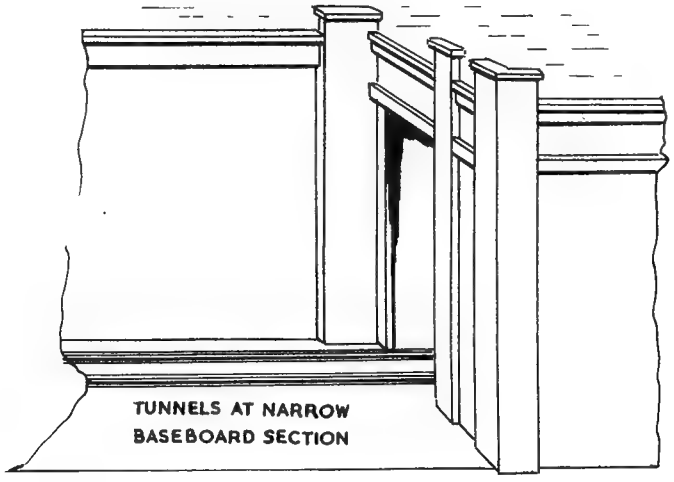
USE OF SWITCH TEMPLATE TO LAY OUT GAUNTLET TRACK



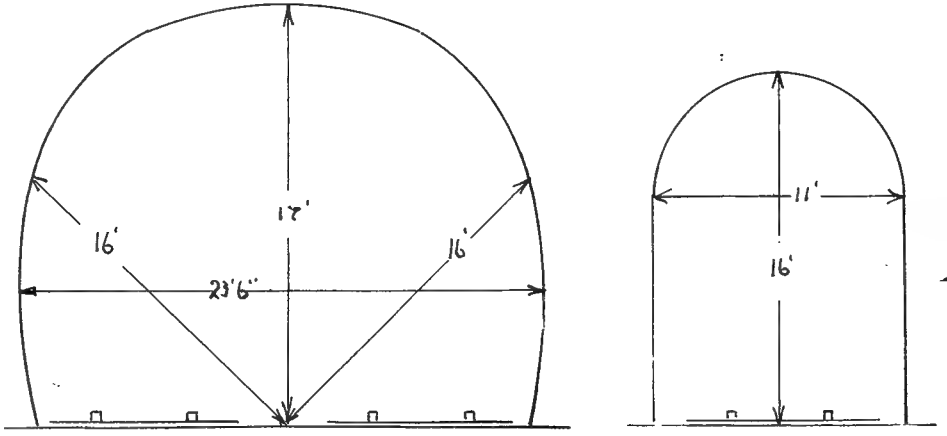
ENTRANCE TYPES



FORMING SCENERY AT TUNNEL MOUTH



TUNNELS AT NARROW
BASEBOARD SECTION



PORTAL DIMENSIONS

FIG. 29

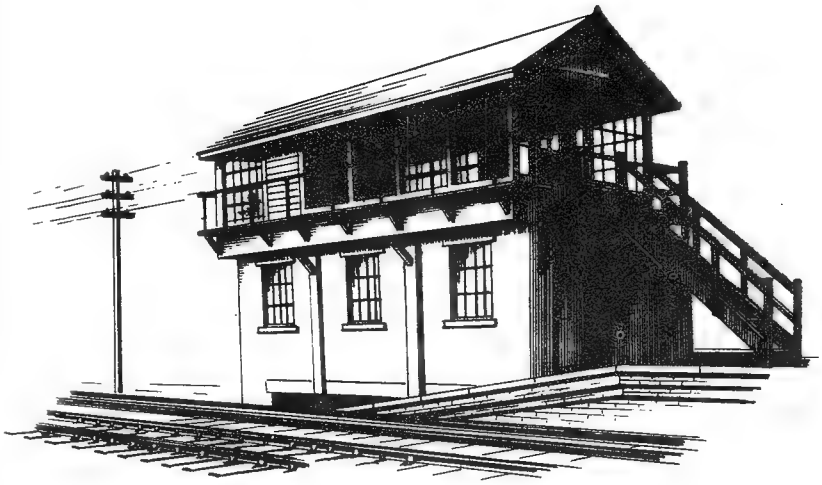


Fig. 30. LARGE SIGNAL CABIN (*Elevations are on following page*)

SIGNAL CABINS

The signal cabin is a very characteristic railway feature carrying more exclusively " railwaylike " lines than perhaps any other architectural item. The range of design from which the builder can select is almost without any limits. It is only possible in this handbook to make a selection of a few types which possess, maybe, a stronger appeal to the eye than the average. Fig. 30 gives the standard timber-and-brick idea, the brickwork, of course, forming the lower portion of the structure, and the timberwork being confined to the upper storey. The cabin here designed has an exterior wooden stairway, and it should be stated that this stairway can be bought completed by the inch at a very nominal figure from G. N. Slater & Son of Timperley, Cheshire. It is a simple matter to fit the handrails, forming them from $\frac{1}{16}$-in. wood strip. A lavatory building is located beneath this stairway, as shown. The method which the writer would adopt in the construction of the glazed portion of the cabin would be to build the walls around full lengths of celluloid window material, capping over the edges where the joints meet, and bringing down the celluloid to the lowest extremity of the wall as well as right up to the eaves. All the mullions and blanks in the walls would thus be laid on the surface of the celluloid, excepting at the rear where there is no glazing.

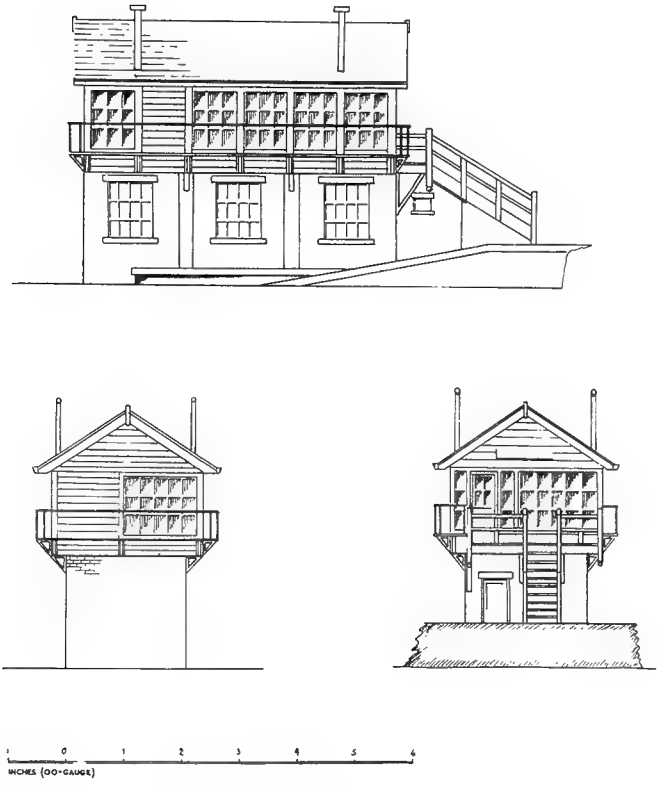
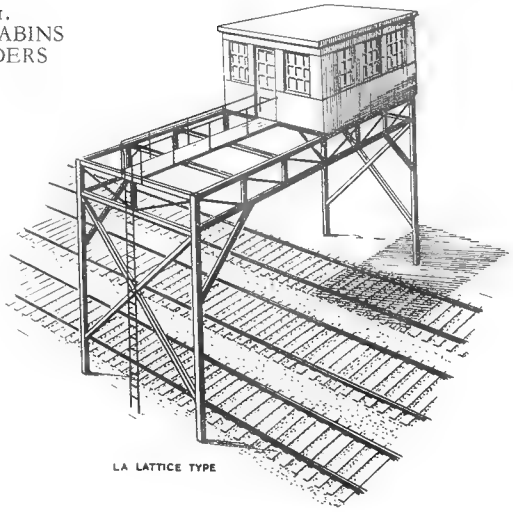


Fig. 30. LARGE SIGNAL CABIN
(*The perspective drawing for this is on the preceding page*)

The two designs of Fig. 31 represent quite striking types both of which the writer has modelled. One of these is the lattice-carried over-track box, the other being similar, but having plate girders in place of the lattice. This kind of modelling provides excellent scope for the adept in fine soldering work—a very fascinating occupation. The main framework can be built from either 00-Gauge running rail, or radio busbar or correct square-, L- and I-section brass strip. For the plate girders, an excellent material is tinplate strip, which used to be obtainable from the Leeds Model Co. in all manner of sizes. Tinplate L-section can also be had as a wagon-making component from Hamblings and other firms, as

Fig. 31.
SIGNAL CABINS
ON GIRDERS



LA LATTICE TYPE

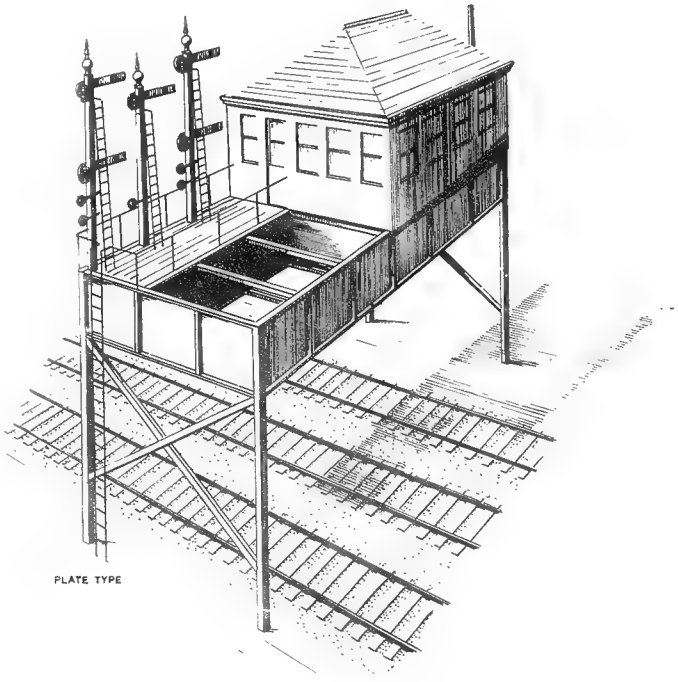


PLATE TYPE

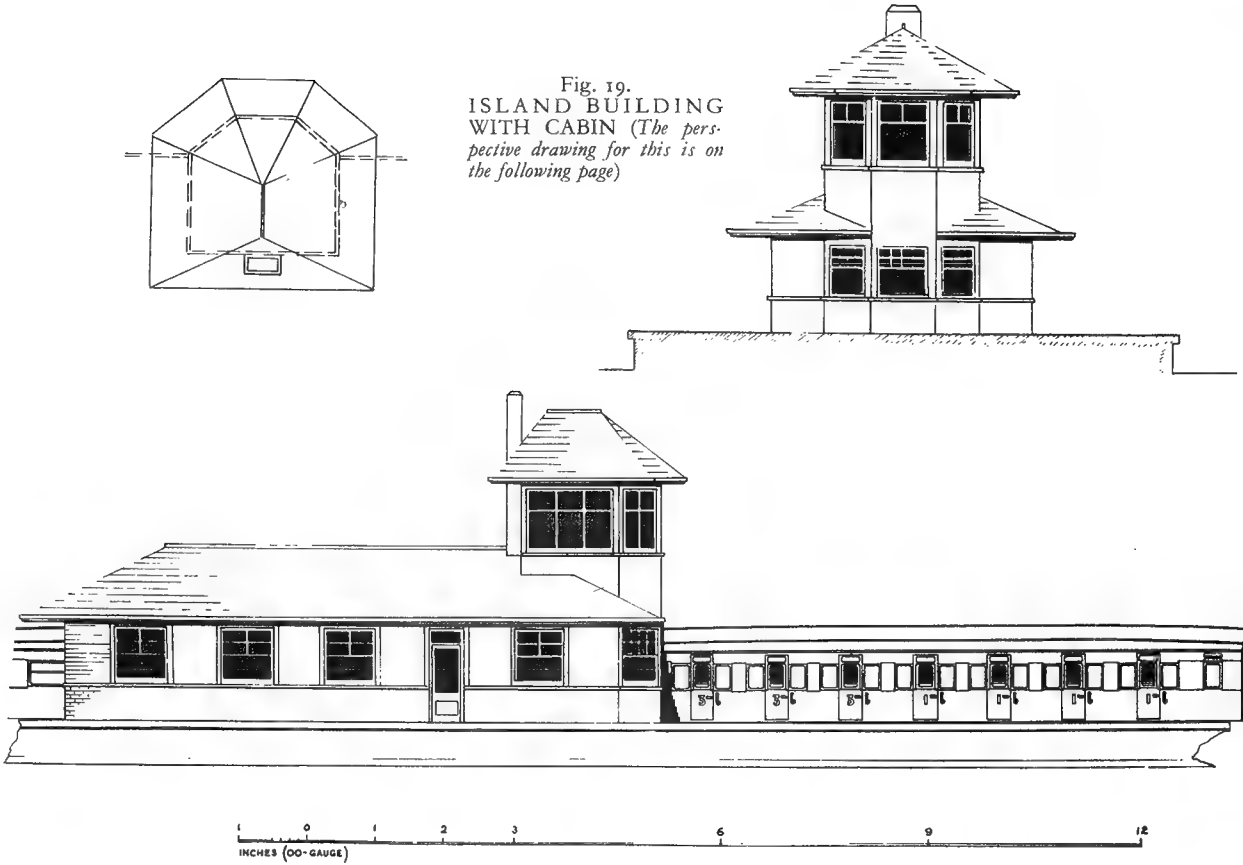


Fig. 19.
ISLAND BUILDING WITH CABIN (*The perspective drawing for this is on the following page*)

FACTORIES AND INDUSTRIAL PLANTS

Scattered about the layout there will no doubt be numerous factories, for these will be found as essential to traffic as freight and passenger stations. They also have the desirable quality of filling up odd corners which would otherwise be vacant and useless. In Fig. 33, therefore, I have given a number of elementary ideas for factory building which will be found generally applicable. Chimney stacks are readily modelled from dowelling or thin rolled card covered with brick-paper, though the tapered type of stack is better finished as concrete, owing to the difficulty of getting the brick-rows horizontal. In A, a suitable base for a stack is formed from a large nut of correct size, which would of course be finished as concrete. In B a plain wooden block is employed; in C, another correct style is given, and this is useful in that it may be used to attach the stack to the wall of a building. Cover the base with brick-paper and glue the edges to the wall, then cover the wall and the lapping edges. An attractive feature is indicated at D, where two buildings are connected by an overhead corridor. The double girders under the corridor should be noted, the corridor itself consisting of a solid block of wood, if so desired, the block being painted black before the windows are fitted. The latter should be formed from a single piece of celluloid covering the entire side, this being afterwards bricked over, leaving the necessary apertures. The roof may consist of a strip of corrugated iron. The sprinkler tower (F) makes an eye-catching item, and can be formed from a reel taken from a coil of adhesive tape, painted aluminium like the conical roof. Ladder, manhole and a signal finial complete the model.

A factory of considerable dimensions requires something more or less ornate by way of office entrance. A suitable style is offered at G, the lamp standards being a most effective commercial line. The inset doorway (H) is more suitable for the industrial part of the building where there is likely to be considerable road traffic. A fire escape for factory use is shown at I and J, and is a simple job if short lengths of commercial stairway are used. The method of fitting the soldered handrails is shown at I. An excellent method of forming a spiral staircase, is shown in L which is taken from a recent issue of the *Model Railroader*. It is in tinplate, cut and bent in the manner shown, and is finally attached to a small peg by means of the hole. This idea was meant to apply to a location where the staircase twists about a tower or tank, but it could just as easily be arranged around a length of stout dowel ling, or soldered to a length of thin tubing.

We have at E a scheme for a factory of quite striking appearance, arranged close up to a background. The building near the wall, in fact,

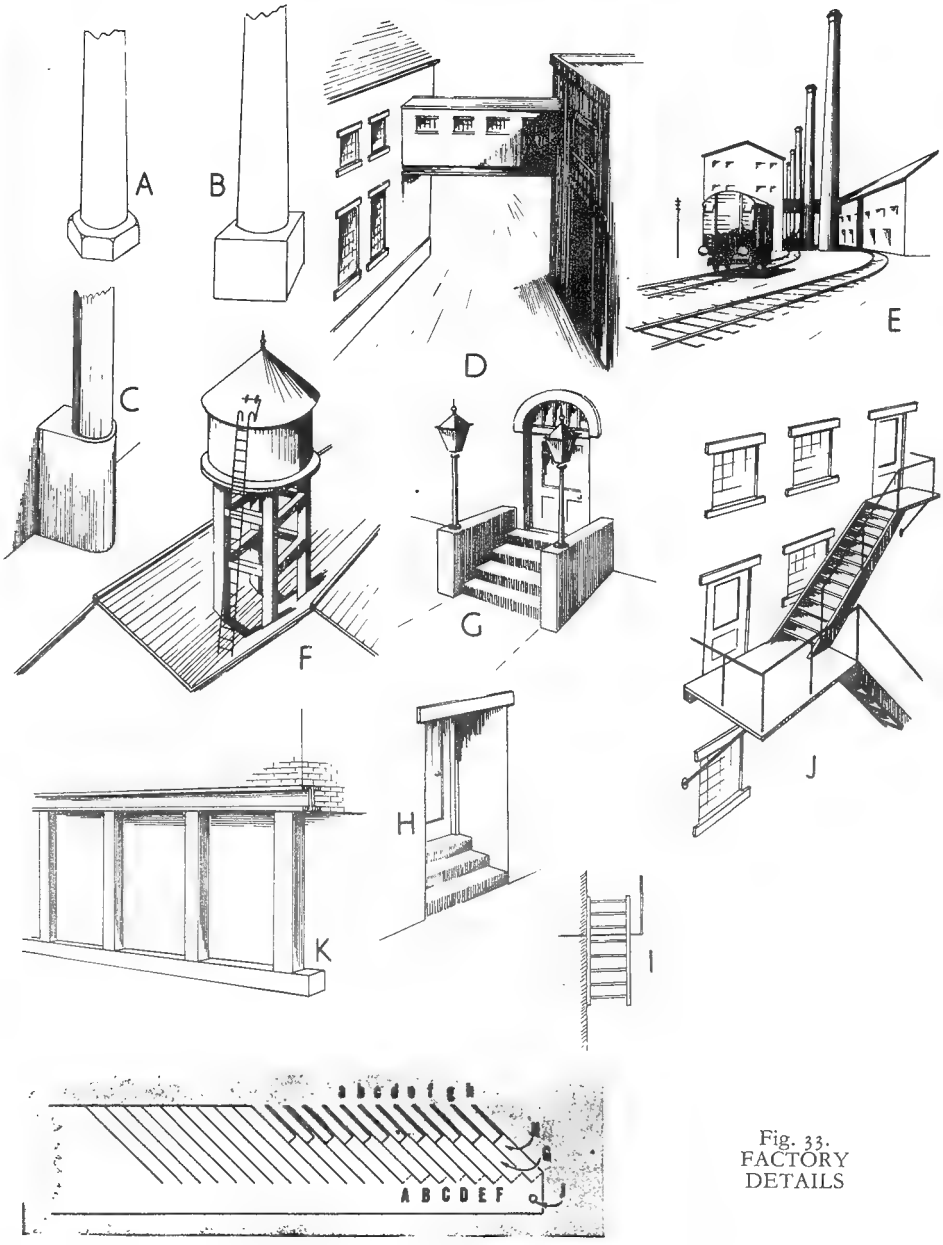
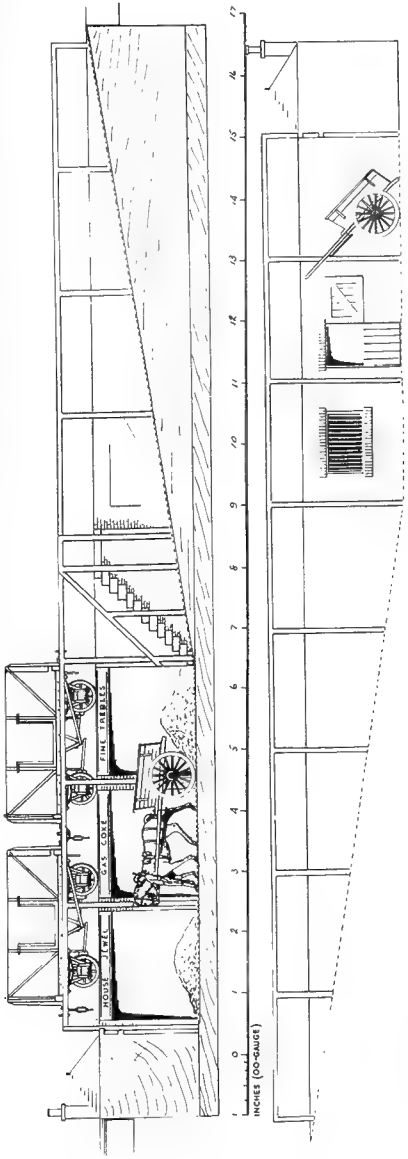


Fig. 33.
FACTORY
DETAILS

may be merely a half-model extending only as far as the roof ridge. The space occupied would then be exceedingly small. In K, we have the necessary girder work, supported by timber or brick columns, where a railway track or lorry road passes beneath the front of a building.



The design of Fig. 34 really belongs to freight-yard features and represents retail coal staithes such as are frequently found at country stations. The scheme is a development and improvement of an early design in which the base of the roadway is let into the formation of the yard. For this purpose it is only necessary to remove a short length of baseboard and to build this up by means of the tapered and squared blocks as shown. The site covered is only 17 ins. by 5 ins. The offices are surfaced around the supporting block at one end. The model will look well if the roadway is paved as indicated, and failing all else, an old-stone paper will serve, if the edges are covered with streaks of brown flox.

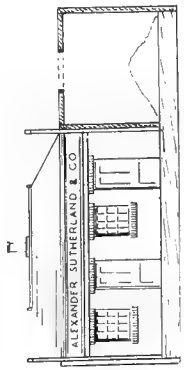


Fig. 34. RETAIL COAL STAITHES

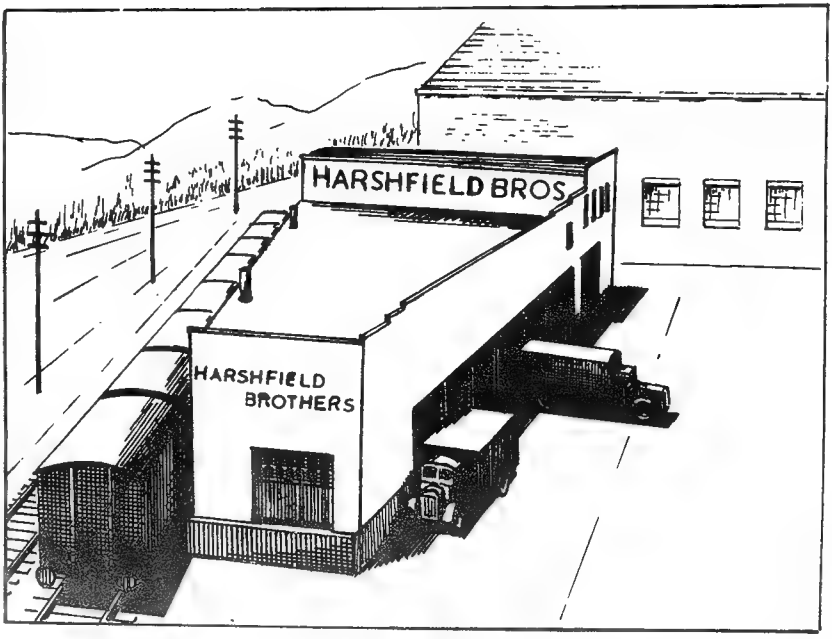


Fig. 35. FACTORY IN THE GENERAL STYLE. ADAPTABLE TO ANY SHAPE OF SITE (*Elevations to scale on the facing page*)

A compact factory of the general style is shown in Fig. 35, and is based on an actual instance. The structural design is very simple, plain and easy to proceed with. Note the inset door at one end. The rolling doors may be either dummies or operative, and in the latter instance consist simply of scribed pieces of card, suitably painted. The exterior walls may be finished in concrete, as in the original, though the " concrete " should be smeared with a little soot, especially around the base.

An oil storage and pumping plant (Fig. 36) is an effective rendezvous for tank wagons. The design given represents also an actual instance on the former Great Western Railway. Six forms should first be made for the tank supports, being cut from thick fretwood or built up from card, and covered with old-brick paper. If the tanks, formed from the cores of string-balls, are painted aluminium, this should be soiled down with a liberal dose of either soot or black paint on a swab, especially underneath and about the front. For the piping (large bore) the best material is Mecanno pivot rodding, and upon this the flange joints are represented by soldered washers. Wheel valves are wagon brake wheels. A finer wire,

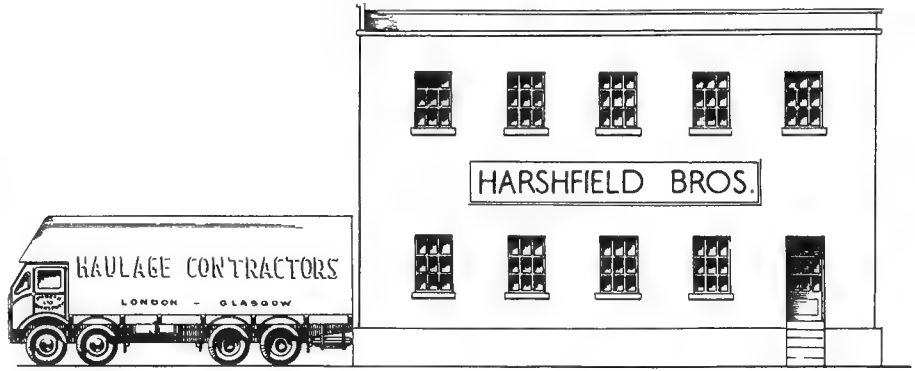
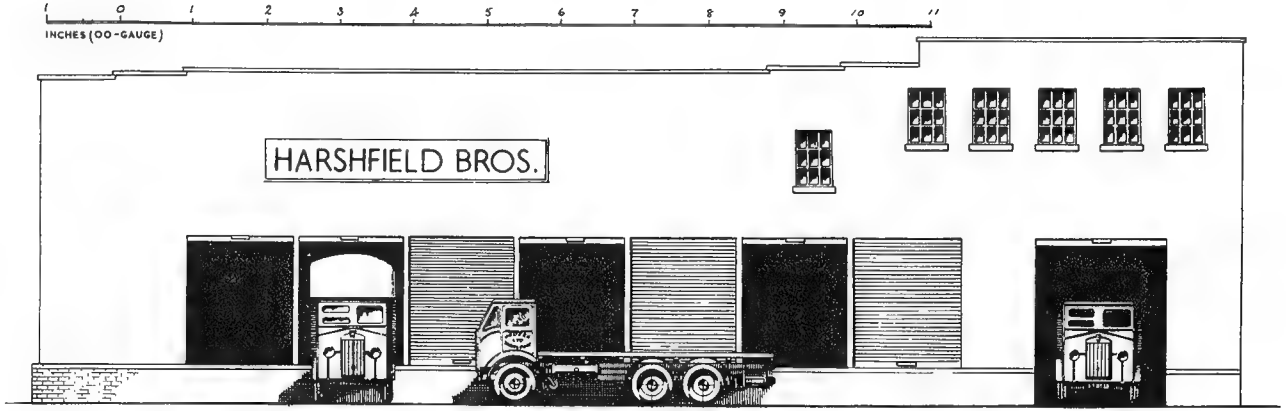


Fig. 35. DESIGN FOR SMALL FACTORY (*The perspective drawing is on the facing page*)



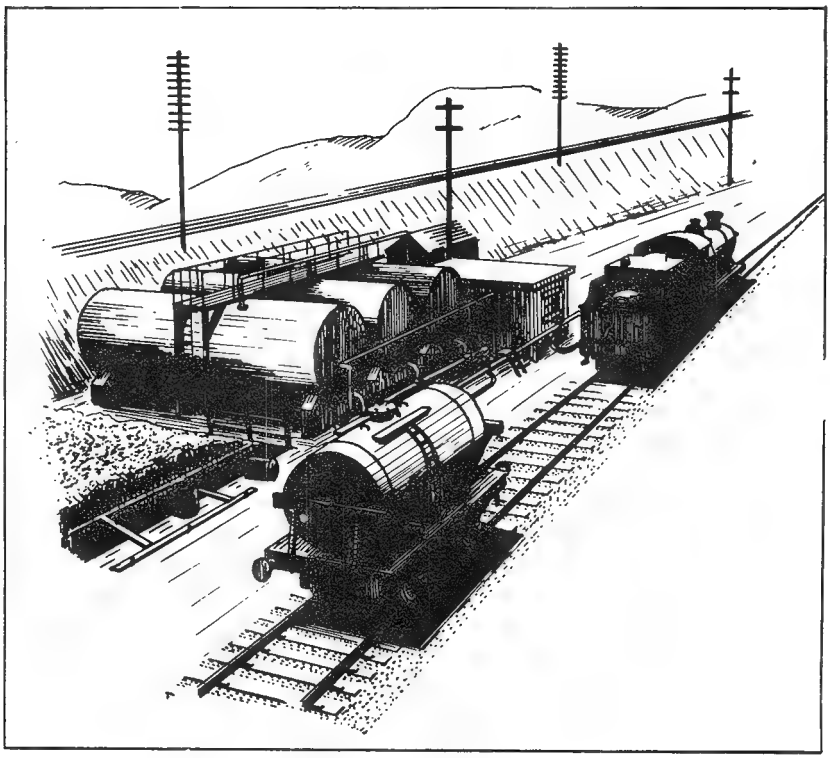


Fig. 36. OIL STORAGE AND PUMPING PLANT
(*Plan and elevation to scale are on the facing page*)

though not too fine, is used for the lighter discharge pipes. In the sketch there is an additional realistic detail—the newly excavated trench, which could be effectively cut in the pulpwood forming the baseboard buttressed with planking and coated with brown flock-powder to represent newly turned earth.

Figs. 37 and 38 give the front and side elevations of something quite new in coal mines. The original prototype is in the Southern States, though in the design given the details of British practice will make it suitably authentic for any modern type of layout. The location is between two rising hills, in a cutting through which the main line of the railway passes. The central feature is a timber or steel trestle about 9 ins. high, spanning the cutting between two tunnel mouths. Over this trestle there runs a narrow-gauge electric railway which discharges its wagons

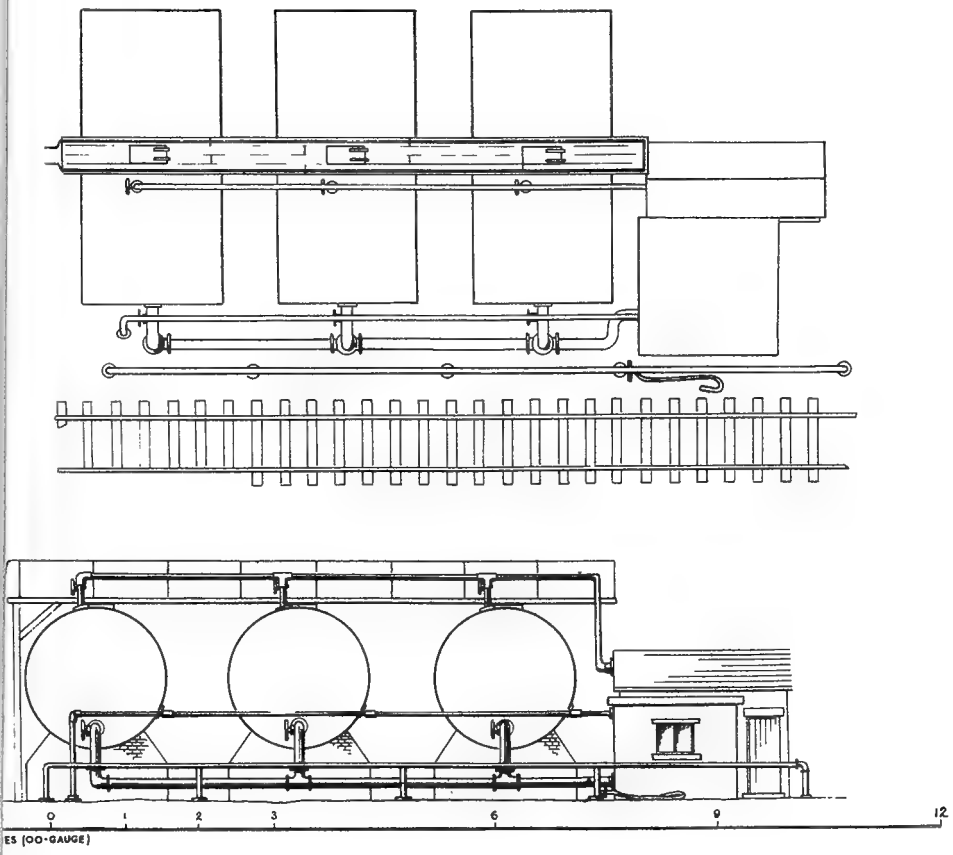


Fig. 36. OIL STORAGE AND PUMPING PLANT
(*Perspective drawing is on the facing page*)

beneath a covered hopper. The various buildings, which are dummies, might be conveniently modelled in solid wood, with angle-wood for the roofs, and this could be largely covered with corrugated iron. The chimney stacks are formed from fine dowelling, with coiled paper on the outside, giving an open top to the stacks. This also, in turn may be painted aluminium and soiled down. The guys for the stacks are an important feature. Narrow-gauge trains may be arranged to run in a circle more or less continuously, if so desired.

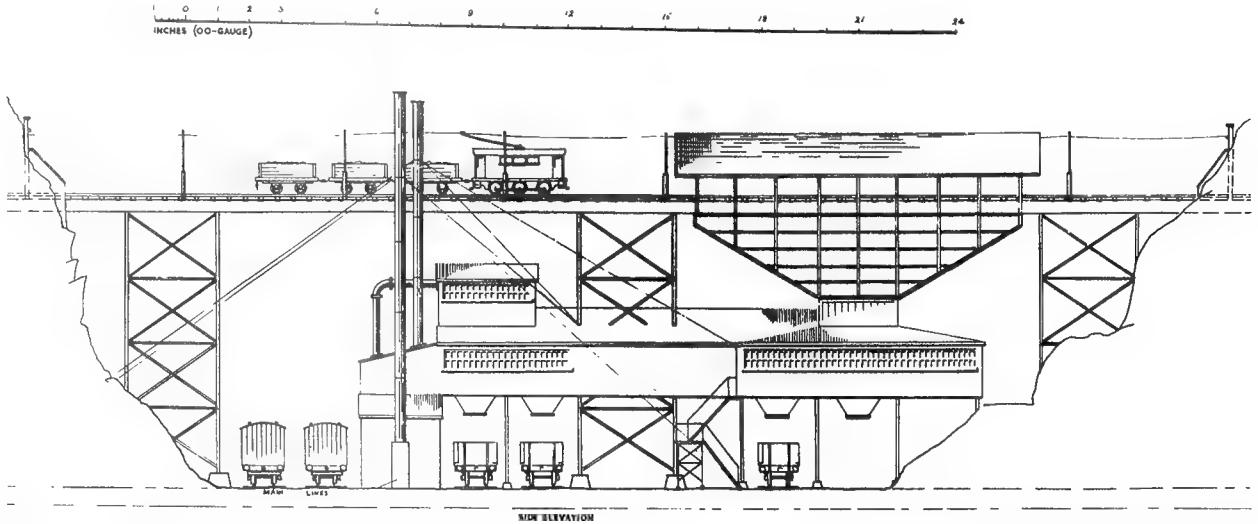


Fig. 37. COAL MINE (*Side Elevation*)

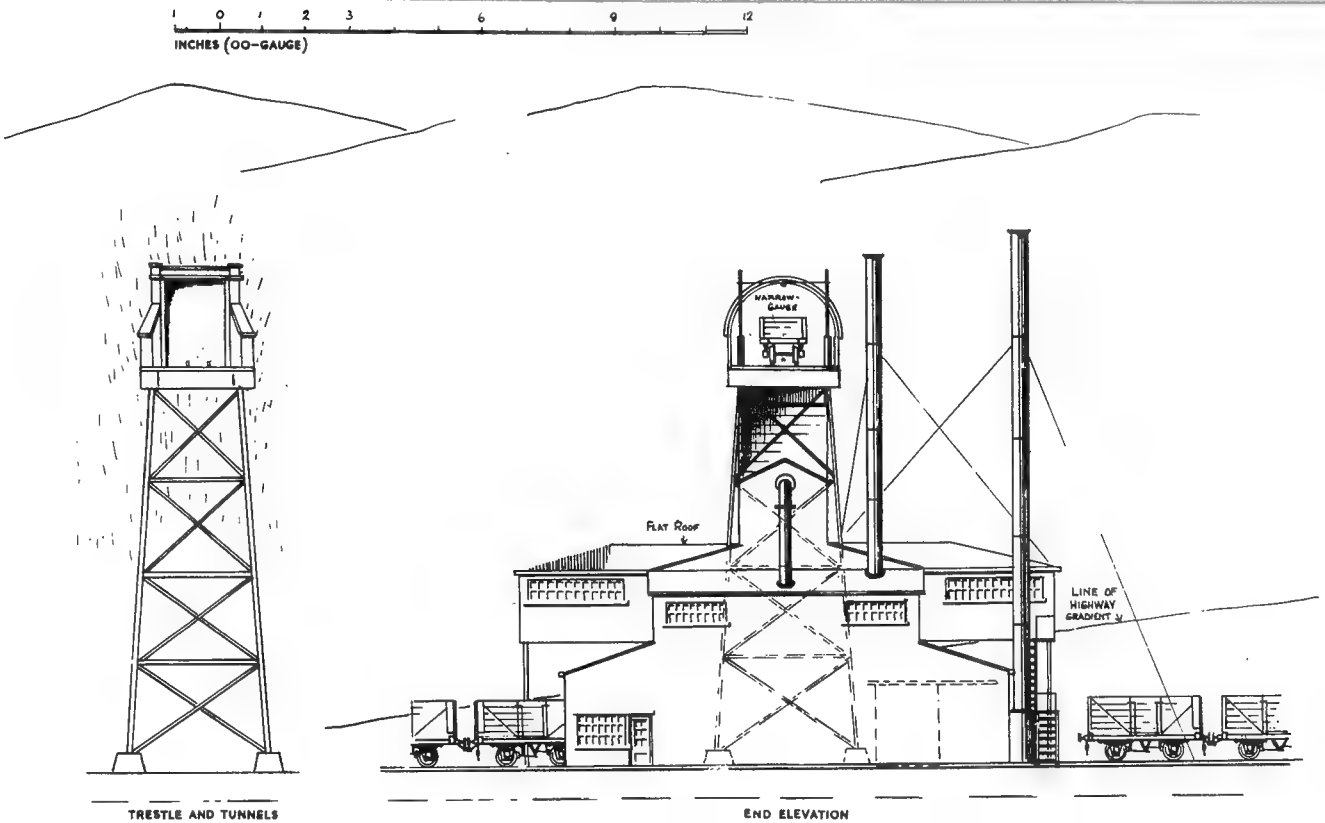


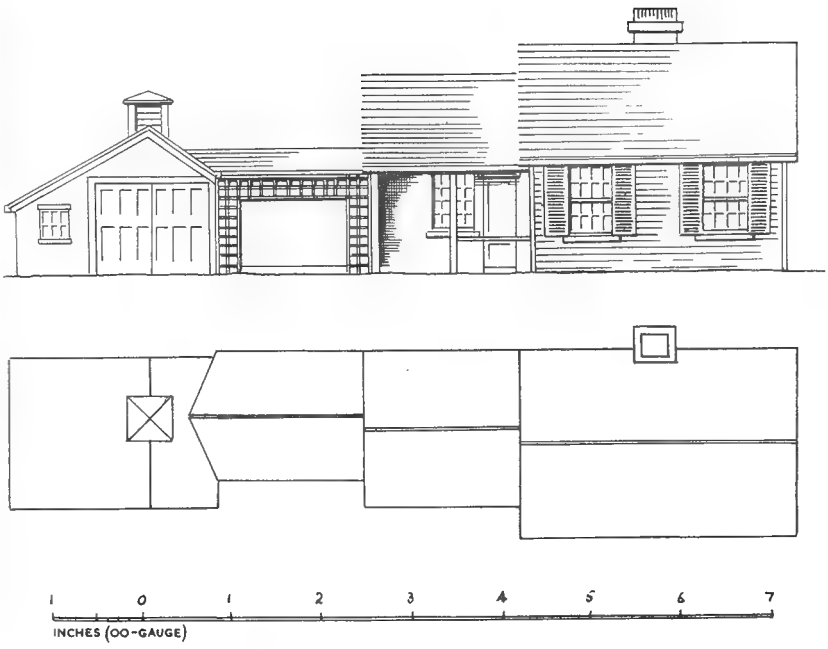
Fig. 38. COAL MINE

Fig. 39. COTTAGES
(*Elevations are on the facing page*)

VILLAS AND RESIDENCES

The subject of house-modelling forms a theme to itself, and cannot be given full justice here for obvious reasons. But one or two representative ideas may be useful. The choice ranges, of course, from cottages to castles, including churches and period houses. Two designs for cottages are given in Fig. 39, one of these being a timber structure, the other brick or stucco. The reader is also referred to the photographs of excellent work by Mr. Ahern and the terrace houses by Albert Kenyon. The timber cottage with garage and railed fence is very attractive and occupies a negligible space. The curvature of the roof is not hard to simulate and should if possible be included. Window shutters consist of pieces of scribed and painted card stuck on. The small brick cottage is very simple, and can occupy any odd corner. A small fowl run and poultry house might be included.

The detached suburban villa is typical of a score of such varied models on the author's layout, being finished in new brick, stucco and dun tile papers. There is little about it to present great difficulty if the instructions already given are followed. The lawns and paths and garden plots about such villas are modelled in green flock powder sprinkled on wet green paint, with dark ballast paper or gravel paper for the paths. Garden plots have brown flock powder, with rows of small evergreen twigs for plants and flowers. An undulating garden surface is easily worked up by using a piece of old casement cloth, which should be



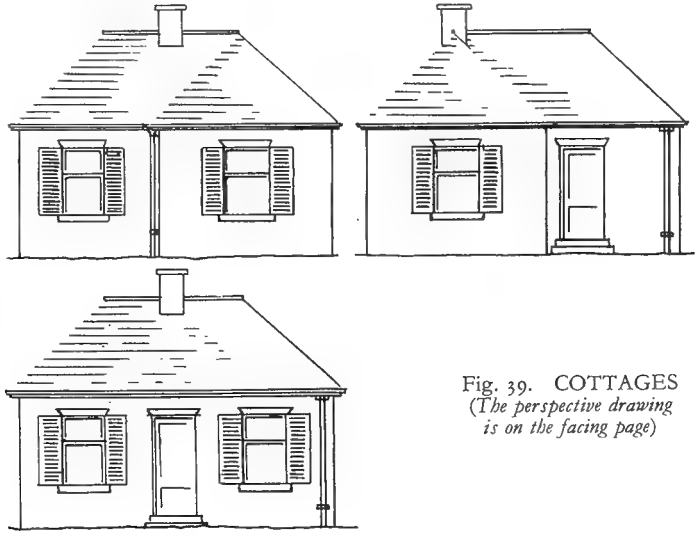


Fig. 39. COTTAGES
(*The perspective drawing is on the facing page*)

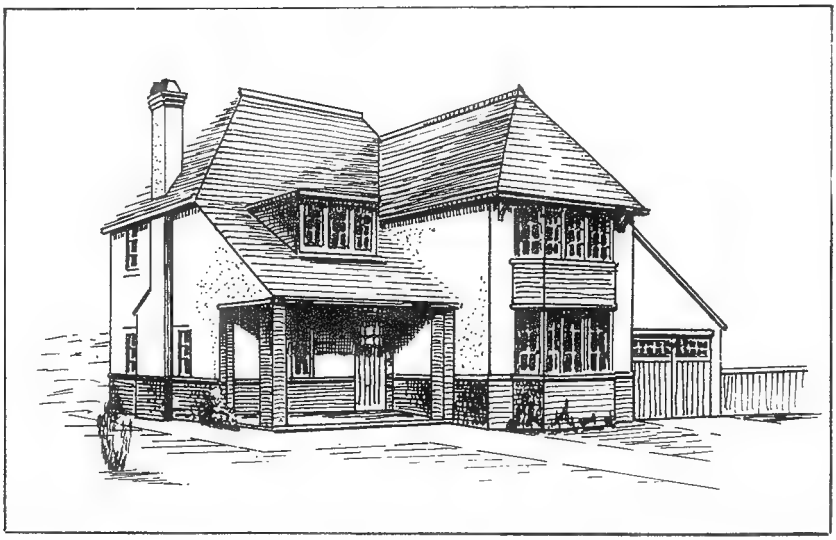


Fig. 40. DETACHED SUBURBAN VILLA
(*Elevations to scale are on the facing page*)

sprigged down with long, thin nails and a nailfix, being stuffed here and there tightly with crumpled paper. The nails should be forced down between the " humps " and the whole coated with green paint. On this there should first be sprinkled patches of brown flock powder then green flock powder over all. Next day the flock powder should be swept off, touches of glue given to the deep hollows and high peaks, and ballast sprinkled on the glue. The effect will be most convincing and satisfactory. Do not carry out any sweeping until paint and glue are dry.

For the picturesque style of Fig. 41, which gives a suitable row of old village buildings for a back wall, a little more detailed skill is demanded. The hotel building is very simple and forthright in style and is without any problems. The ornamental chimney work is worth some patience. The framed and thatched period houses are more advanced, though the thatching is the only unusual item. The best method I have found of doing this work is by using medical lint on a plain cardboard surface. Give the cardboard roof a coat of glue and cover it with a piece of lint with plenty of overhang. See that it sticks well about all the edges especially, and, when dry and set, glue-coat it and lay on a second covering. When all is dry, take a pair of good sharp scissors and trim off the edges with care. Paint the lint a dark brown colour. Chimneys should of course be in

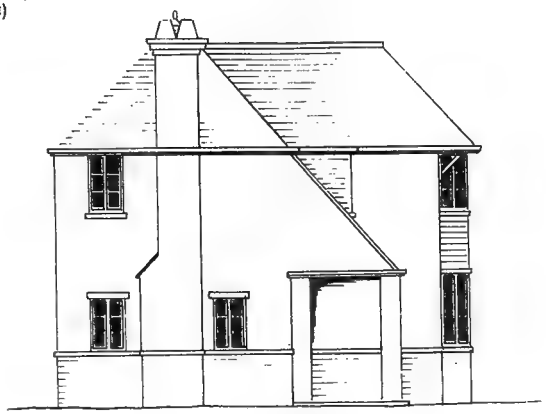


Fig. 40. DETACHED SUBURBAN VILLA
(Perspective drawing is on the facing page)

Fig. 41. OLD HOUSES (*Elevations to scale on the facing page*)

place before the lint is fixed. The wall framing is best carried out by first coating or painting the wall, then painting the wood strip, and finally fixing the strip when the paint is dry. Roads and street pavements can be perfectly simulated with Kenyon's or Modelcraft papers.

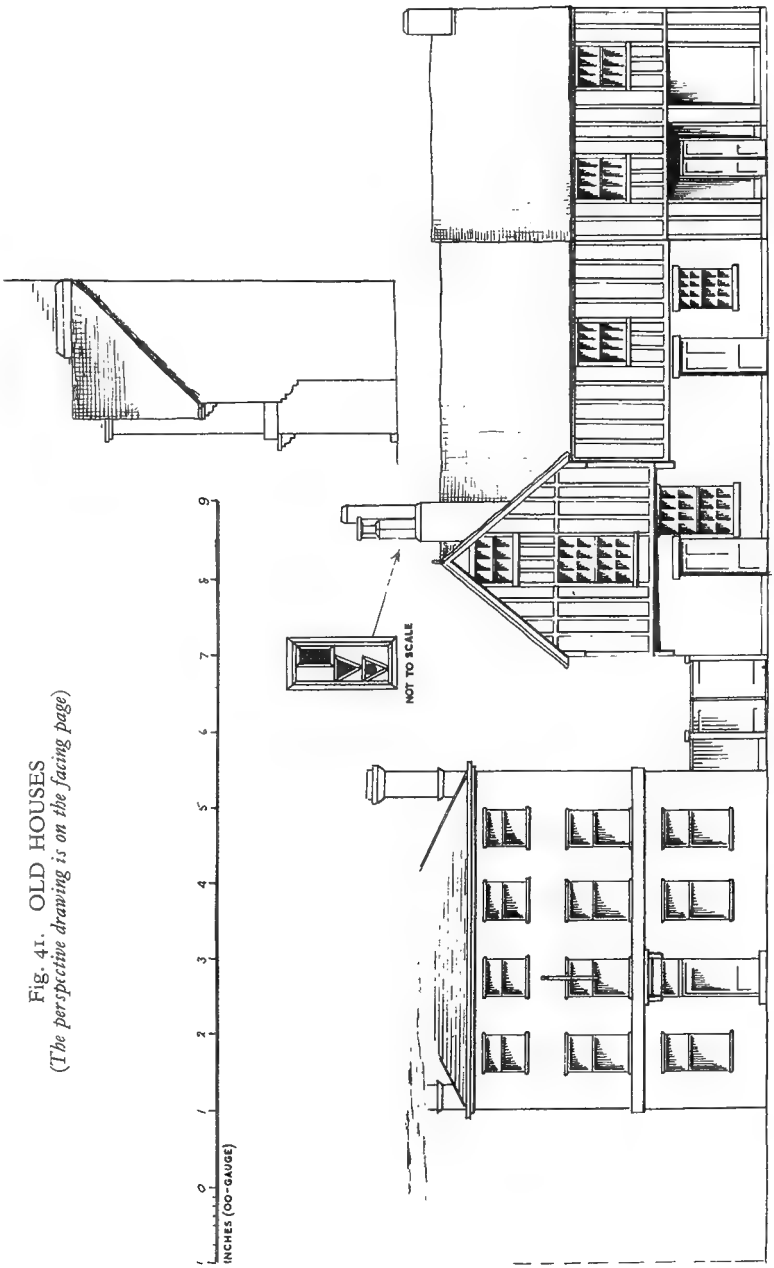


Fig. 41. OLD HOUSES
(The perspective drawing is on the facing page)

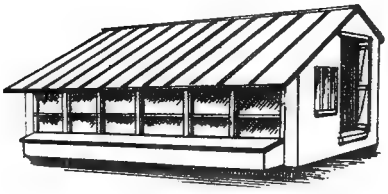
SUNDRY DETAILS

The small models " for farm and field " which appear in Fig. 42 may seem redundent to the railway modeller, as they did to me until I modelled some of them. I then found them exactly what was required for a final finish. A small cottage makes a very unnatural-looking detail by itself, but a few out-buildings add the completing touch. The items in this diagram are all faithful replicas of the real thing, and the work entailed in building them is just the thing to occupy an evening hour and a corner of the table. There are of course hundreds of such items to be selected from—so many indeed that they warrant a separate treatment under such a title as " Aids to a Final Finish."

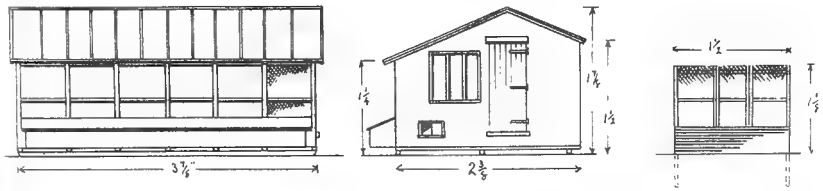
The utility fowl house was built in cardboard, with a strip of solid wood for the outside nest-boxes. The work began with the house front, which was worked up in a piece from the length of stripwood. For the wire netting an ideal material was found, having the exact form of mesh required, in a strip of discarded veiling. This was stretched and glued on the inside of the slats. Then, when the front was finished the remaining walls were attached, the floor and roof added. The inside was painted with white water colour, the outside with flat black oil paint. The netting was left unpainted. A few fowls can be shaped up to scale in the fingers from plastic wood and suitably painted. A good foundation is a pin bent double to form the legs.

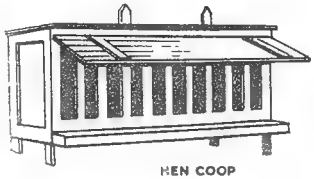
For the hurdles—a very effective detail—the same veiling is used, and the smaller coops can be made up from the solid.

I am indebted to various helpers for the use of excellent photographs of architectural features. These include numerous outstanding 0-Gauge models of railway stations and depots by Model Structures Co. of Santa Cruz, Ca., the frame cottages by Star Line, the terrace houses by Albert Kenyon, and the beautiful item of garden modelling, as well as the villa, by Mr. G. Atkinson. Mr. Ahern's photograph will be its own commendation. The various items of my own photography and modelling work include the cottage, fowl house and greenhouse, the two views of the brewery building with its 96 windows, the country goods shed and cattle dock, the quarry, dairy factory, coal bank and oil storage tank, the villa known as " Home Lea " at Methven, Laurenceton Station building, church and garage, roadhouse and villa, locomotive depot and " Anorma " shops with fitted window displays. The automobiles which appear in several of my own photographs are scale models of actual examples.

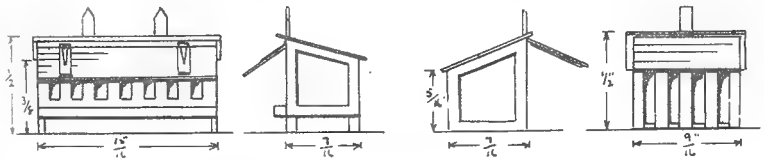


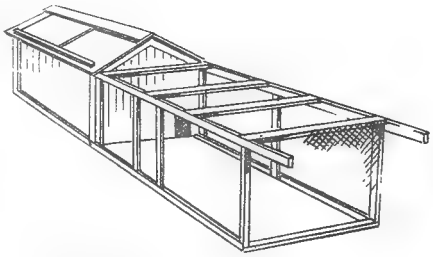
UTILITY FOWLHOUSE





HEN COOP





CHICKEN REARER

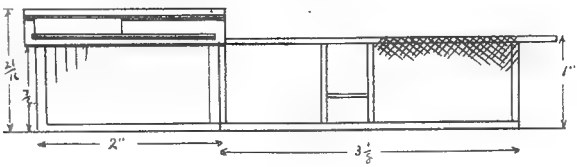
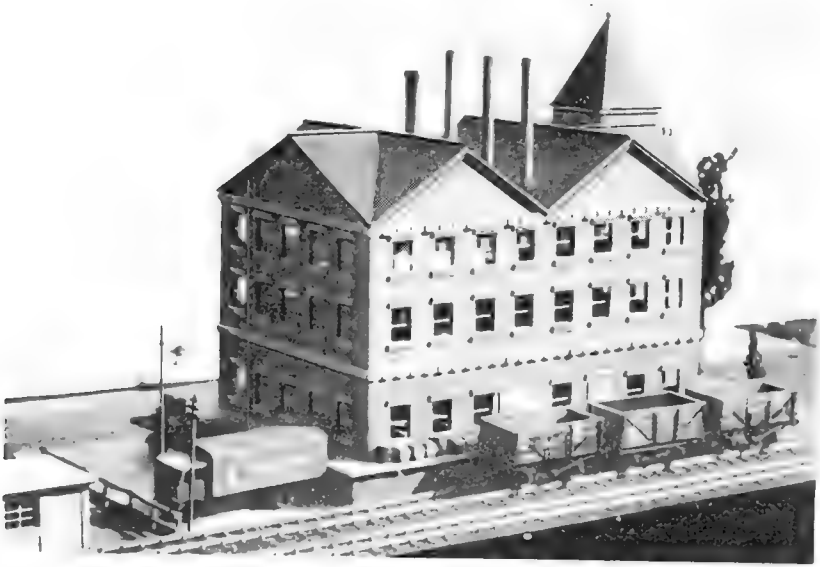


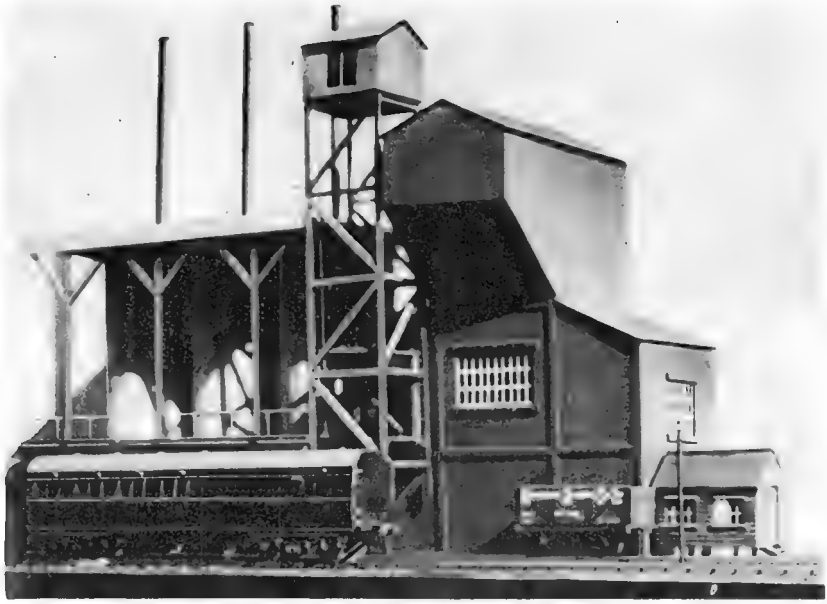
Fig. 42. FOR FARM AND FIELD



BREWERY BUILDING (WEST VIEW)

BREWERY BUILDING (EAST VIEW)

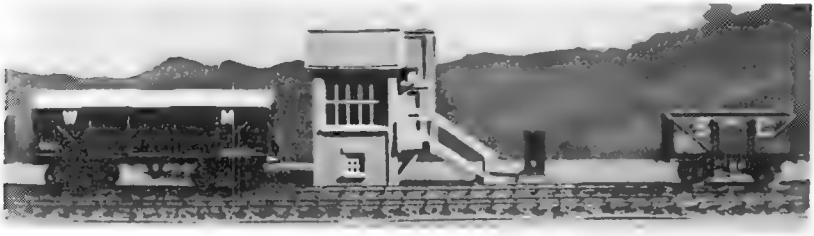
DAIRY FACTORY



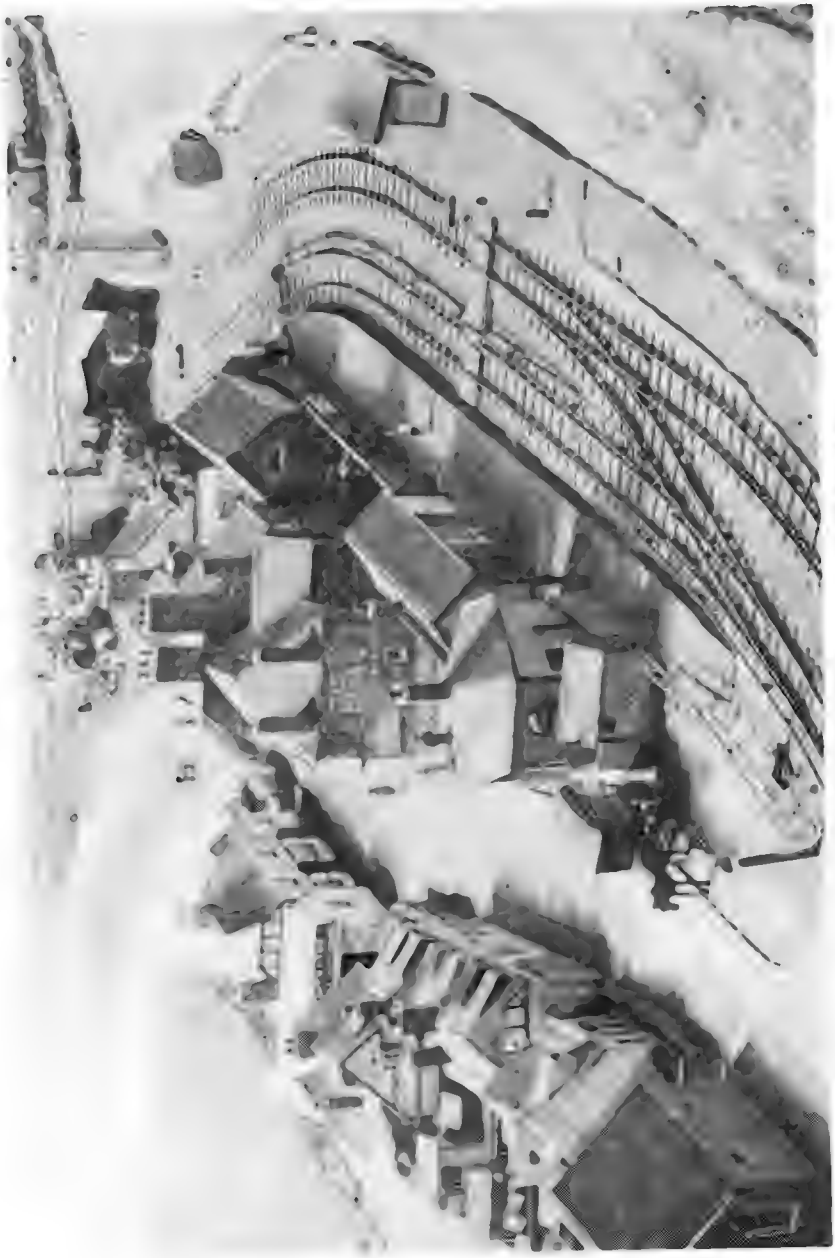
QUARRY BUILDINGS

SMALL COUNTRY GOODS SHED

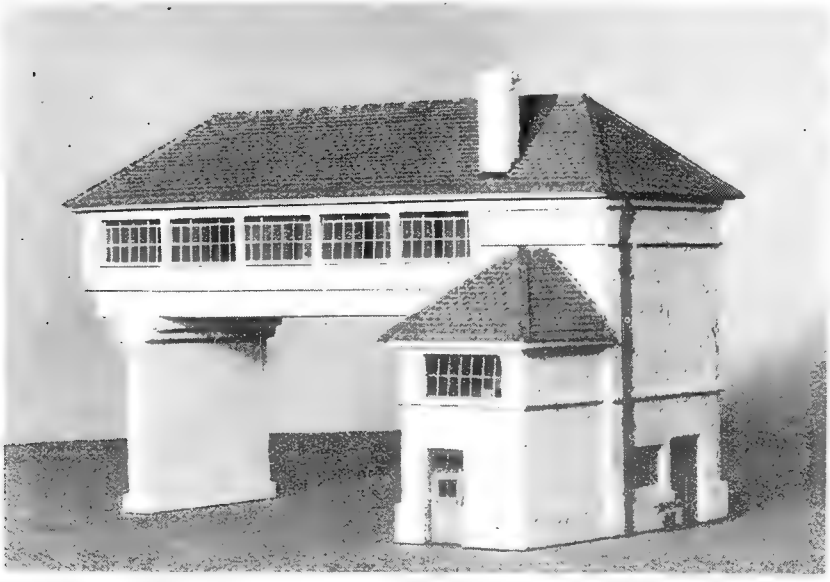
OLD-STYLE COAL AND OIL STORAGE DEPOT



HIGHLAND RAILWAY CABIN (OO-GAUGE) MODELLED IN WOOD



REMARKABLE MODELLING BY MR. JOHN AHERN



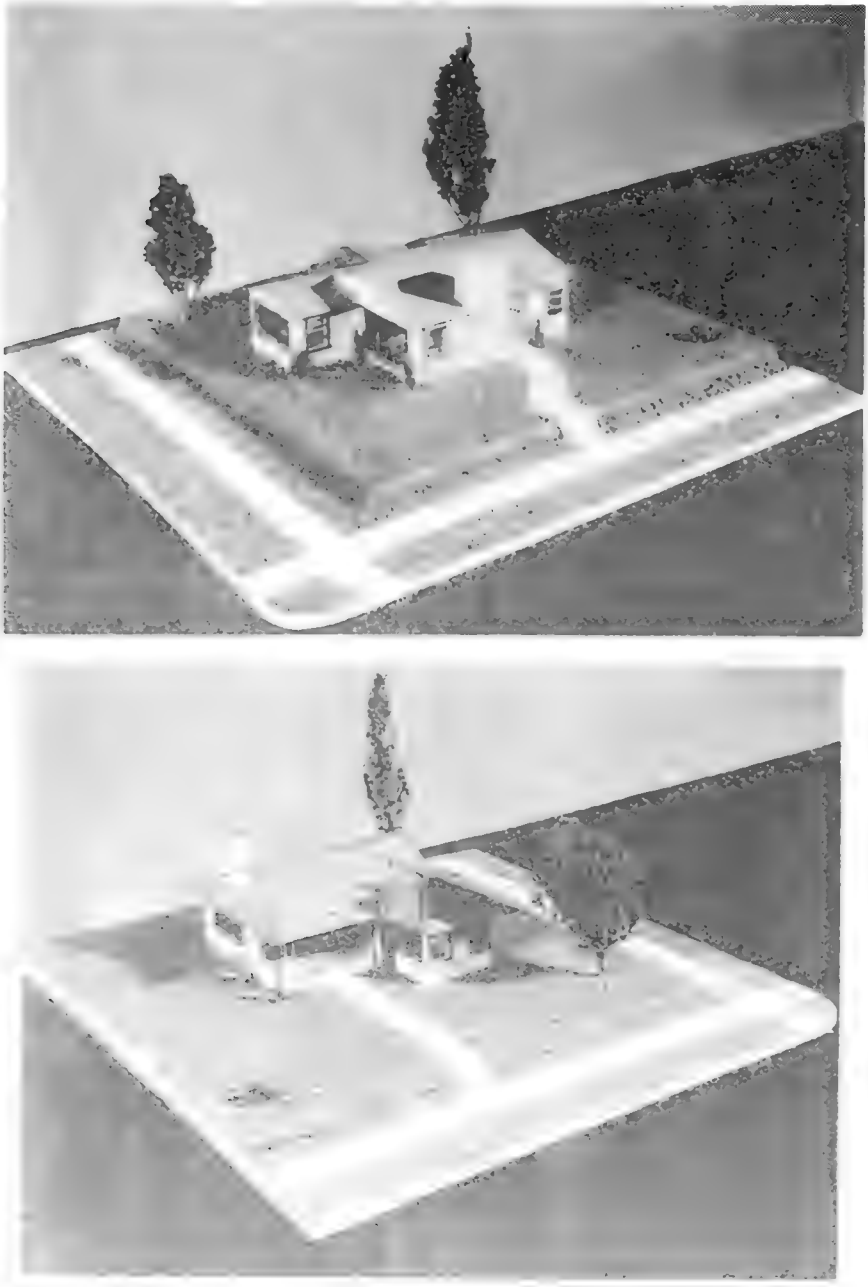
STUCCO SIGNAL CABIN

LARGE BRICK CABIN

STANDARD MODERN CABIN

TERRACE HOUSES BY ALBERT KENSON

SOME FINE GARDEN MODELLING BY MR. G. ATKINSON



AMERICAN COTTAGES BY STAR-LINE Co

'NORMA' COUNTRY INN

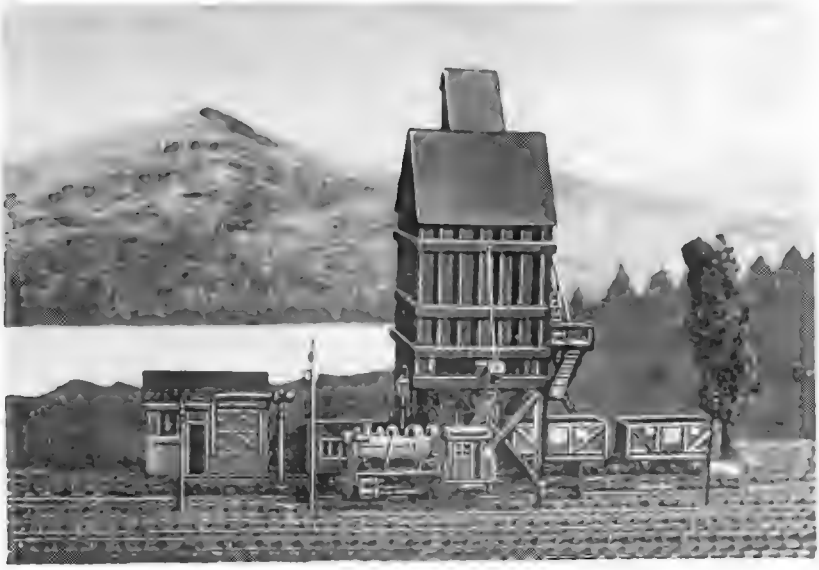
'HOME LEA' VILLA RESIDENCE

ROADHOUSE AND VILLA

WINDOW-DRESSED SHOPS AND CORPORATION HOUSES

CHURCH AND GARAGE WITH VAUXHALL CAR

MAIN TERMINUS BUILDING



A SMALL LOCOMOTIVE DEPOT

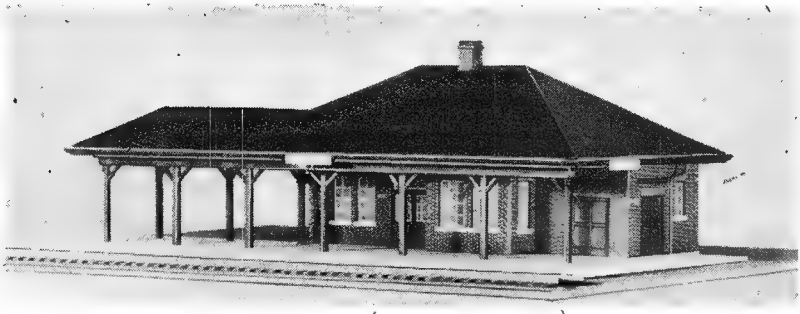
GLASSHOUSES OF A MARKET GARDEN

FEED STORE (MODEL STRUCTURES)

AMERICAN TERMINAL STATION (MODEL STRUCTURES)

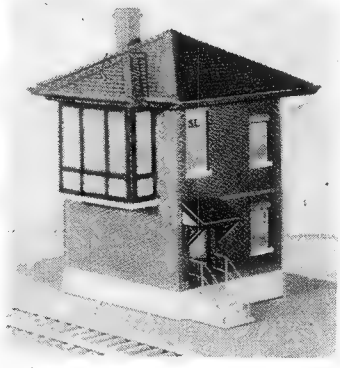
LARGE TERMINAL BUILDING (MODEL STRUCTURES)

PASSENGER AND FREIGHT STATION (MODEL STRUCTURES)

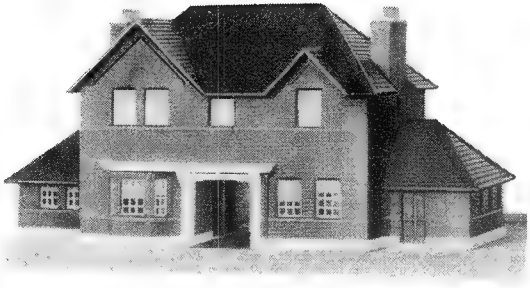


WAY STATION (MODEL STRUCTURES)

MODERN PLATFORM AWNING (MODEL STRUCTURES)



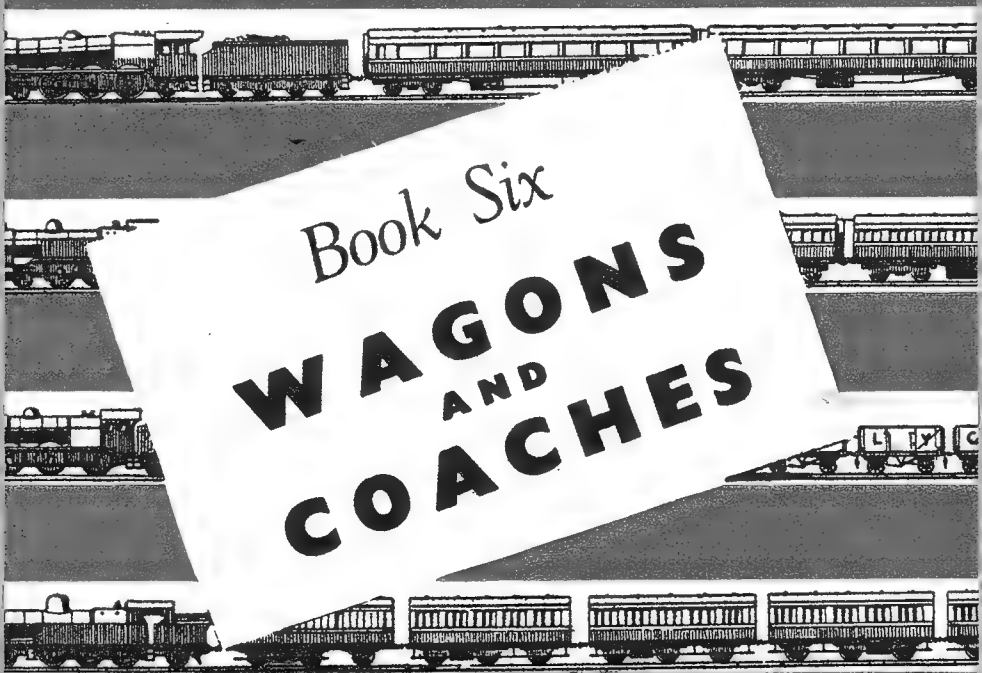
BRICK SIGNAL CABIN
(MODEL STRUCTURES)



BRITISH STATION
(MODEL STRUCTURES)

Edward Beal's

RAILWAY MODELLING SERIES



Book Six

WAGONS AND COACHES

Published by

Modelcraft LTD

77, GROSVENOR RD., LONDON S.W.1

Edward Beal's Railway Modelling Series

BOOK SIX

WAGONS AND COACHES

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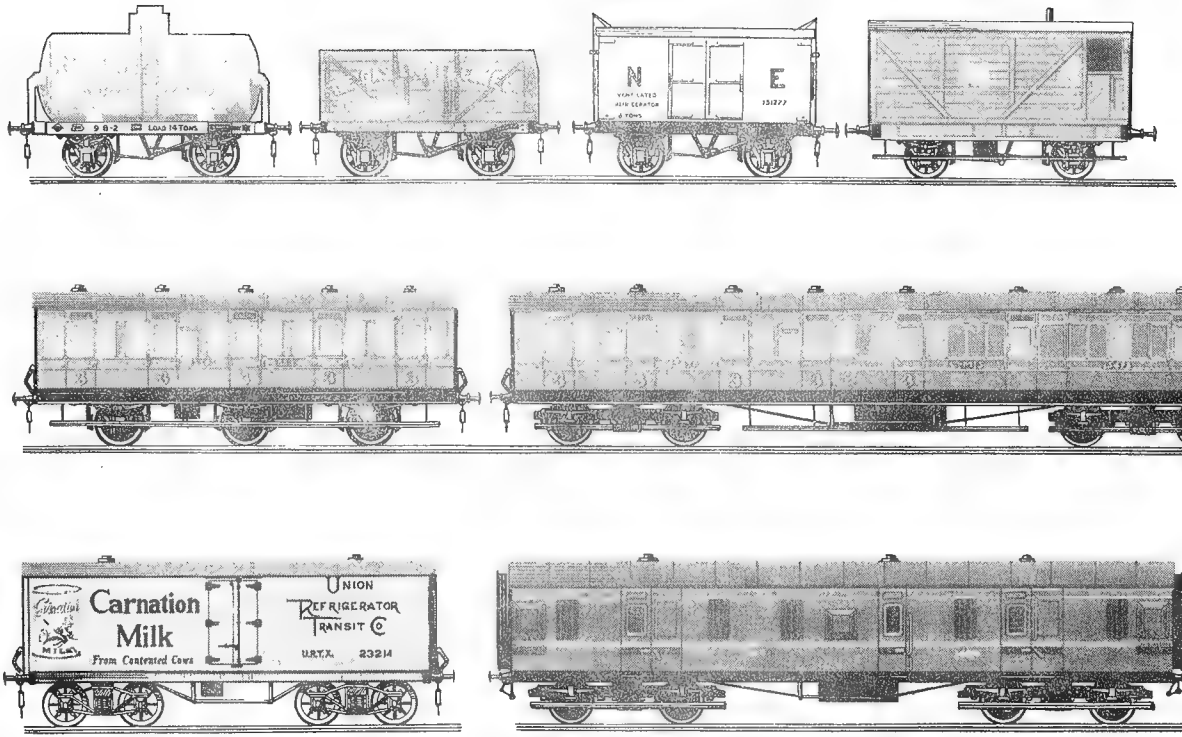
MODELCRAFT LTD., LONDON



LITHOGRAPH PAPERS IN USE

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COACHES

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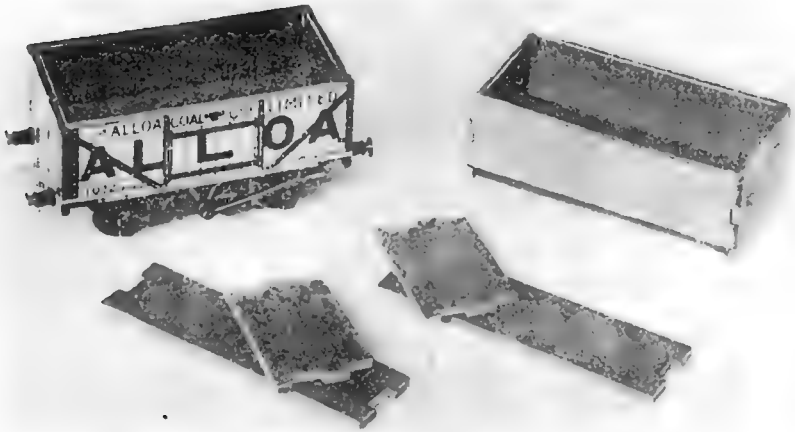
WAGONS

THE building of miniature models of goods wagons is an art which during the past decade has progressed considerably. The various methods of construction in vogue before the war are still largely followed, but in every instance there have been great improvements and developments. The builder has his choice of various lines of procedure, and must decide for himself upon the merits of the lithographed-sided vehicle, the handbuilt, and the use of numerous kits and components provided commercially.

The writer has built hundreds of lithographed wagons, and was indeed responsible for the early designs which were certainly, in their day, a boon to all workers. Nor is this method devoid of merit even yet, for the poorer designs have been eliminated and newer ones added to the series, and a lithographed vehicle may be thoroughly super-detailed to the taste of the most pedantic. There are also one or two of the litho papers which have their uses even on handbuilt stock—those types which, like the tank wagon covers and the refrigerators, do not involve any projecting struts and so forth, and would require to be worked up on some paper surface in any case. The range of choice for litho sheets is very wide, and the prospective user should get into touch with Messrs. Hambling or Modelcraft for the requisite information on this subject, these firms having their own litho series. Open wagons, tanks, vans, cattle wagons and brake vans in considerable variety can be had.

THE LITHO SYSTEM

I have given in the frontispiece some compositions in which litho sides are employed for goods and passenger stock, in order that the finished appearance of these vehicles may be judged. Assuming that we are about to build an open wagon, there are several methods of forming the body. G. E. Mellor provides a set of fibre sides and ends for the purpose, the corners being dovetailed to fit each other. Hamblings provide ready-cut standard bases or floors for such wagons, and several firms—Mellor, Hambling, Reidpath and Walkers, as well as E. R. Gray—have completed under-frames or chassis, as well as separate axleguards and side frames and wheels. The photo on page 5 shows a set of Mellor parts for an "Alloa" wagon. The work begins with the gluing of the sides together



"ALLOA" WAGON PARTS BY MELLOR

OPEN WAGON BUILT FROM ERG
"MASTERPIECE" PLASTIC KIT

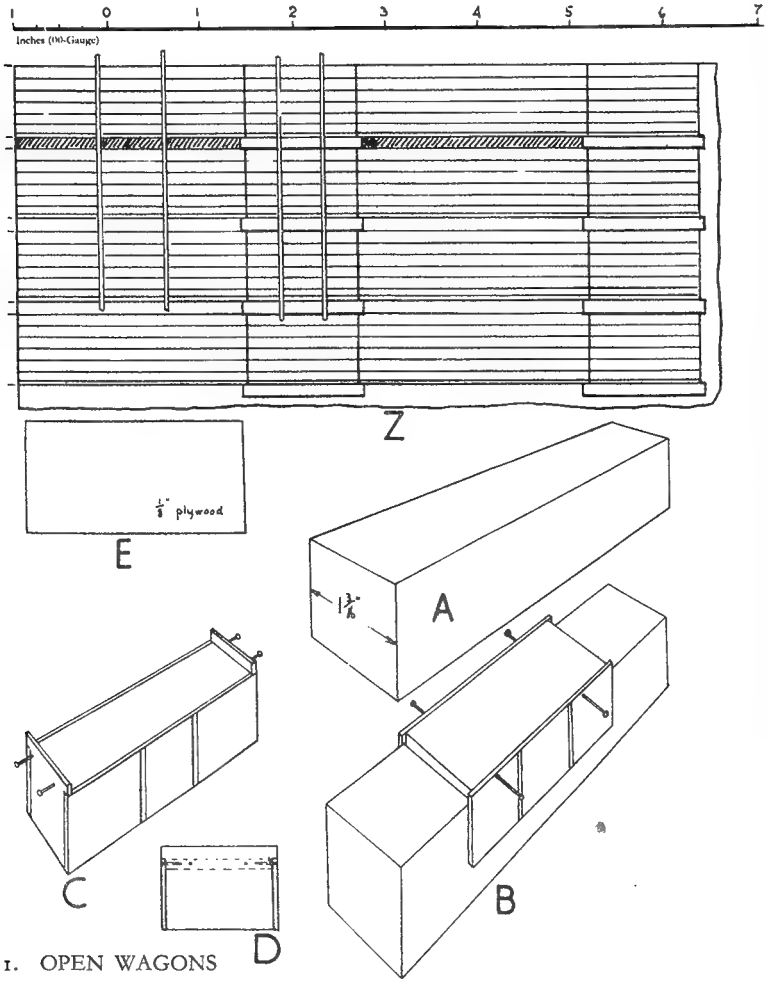


Fig. 1. OPEN WAGONS

and the attaching of the finished sides to the floor. It will be noticed that the lower edges of the wagon ends project a full eighth-of-an-inch lower than the sides. The buffers are screwed in through this projected headstock later. It is desirable to buy under-frames already equipped with full dummy brake gear for 00-Gauge, though when this is only provided in part, it is not difficult to complete the outfit. The sides of the wagon, of course, must be tested before starting to see if that they are exactly identical with the particular papers to be used as lithos.

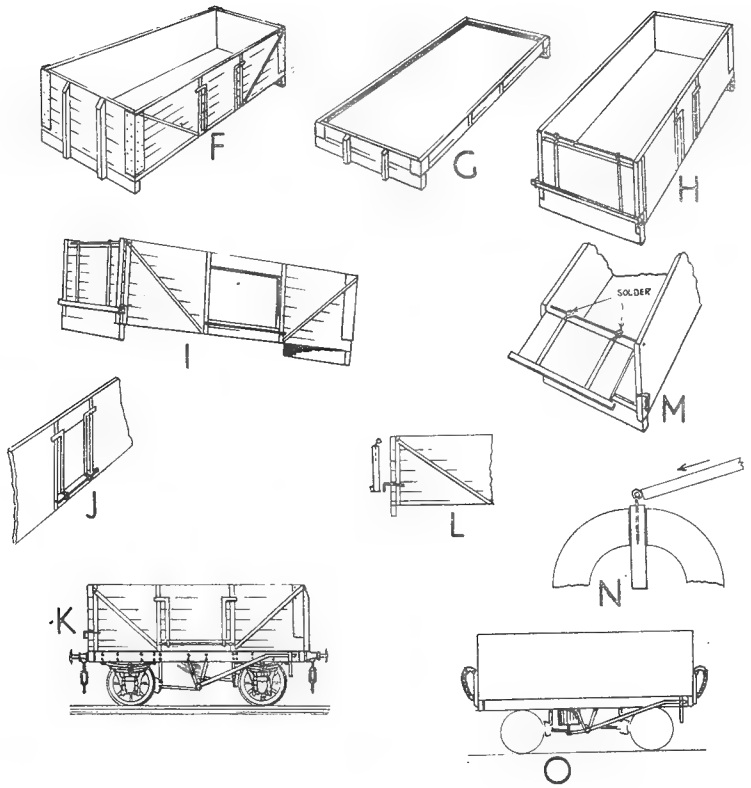


Fig. 1. OPEN WAGONS

In building a van, the body may either be fabricated from wood sections or may be formed from a solid block, though such a block must be provided with ends to come down and form the headstocks.

The details given in Fig. 1, though actually intended to give guidance for handbuilt stock, will serve admirably up to a point for litho wagons. Taking the open wagon first, in A we have a solid block of planed wood $1\frac{3}{16}$ in. thick. Its use is shown in B, where the two ends have been glued at their edges to the floor and pinned with small pins driven in about $\frac{1}{8}$ in. These are then cut off and driven right home. Note that sides project beyond the floor to a distance suitable to take the ends. The block is now dispensed with and the ends fitted as at C, the pins being cut off as before. The body is now ready for the lithos. For a van, to build up, consult Fig. 2. D and E are floor and roof pieces, while in Z we have the marking

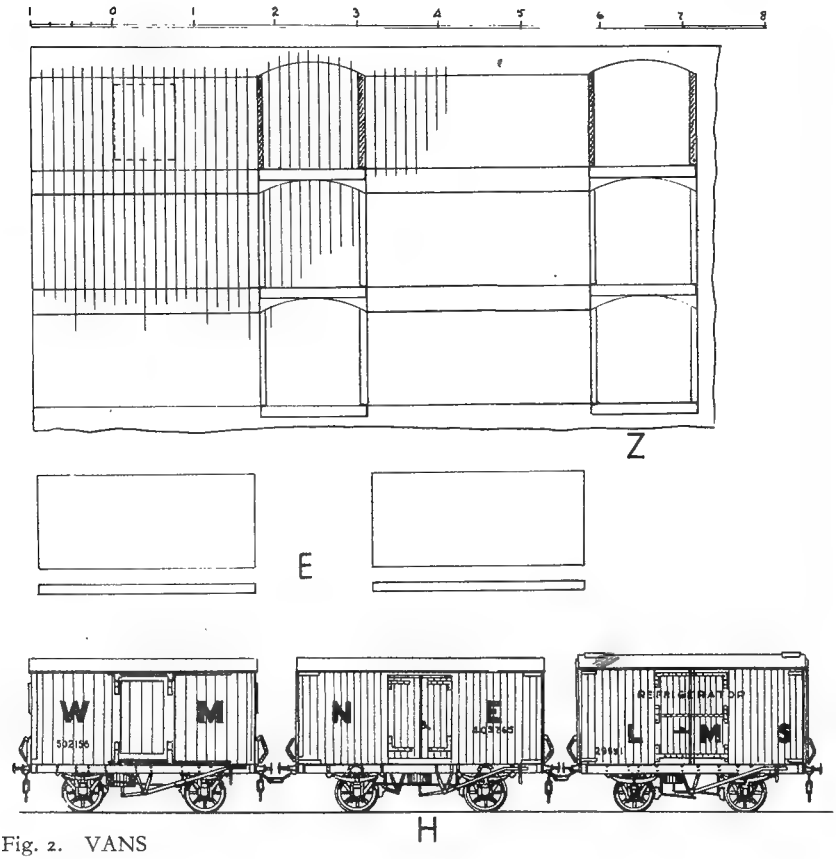


Fig. 2. VANS

out of the sides and ends. The lining and details may be neglected at this stage. The sizes of these parts will, of course, be determined by the dimensions of the lithos used. The hatched portions should be cut right away. In A we have again the block of wood, and for a van body it must not only be of the right thickness but also of the correct height—high enough, that is, to slip between the floor and roof snugly when these are in place. Build up the sides, roof and floor around this block. If several vehicles are to be built alike the use of this block is obvious. B shows the four pieces in place, with an additional strip along the centre of the top. Now remove the body from the block and fit the ends as in C, not omitting to chamfer off the top edges of the sides to take the roof. The latter consists of two pieces of post-card or Bristol board separately curved

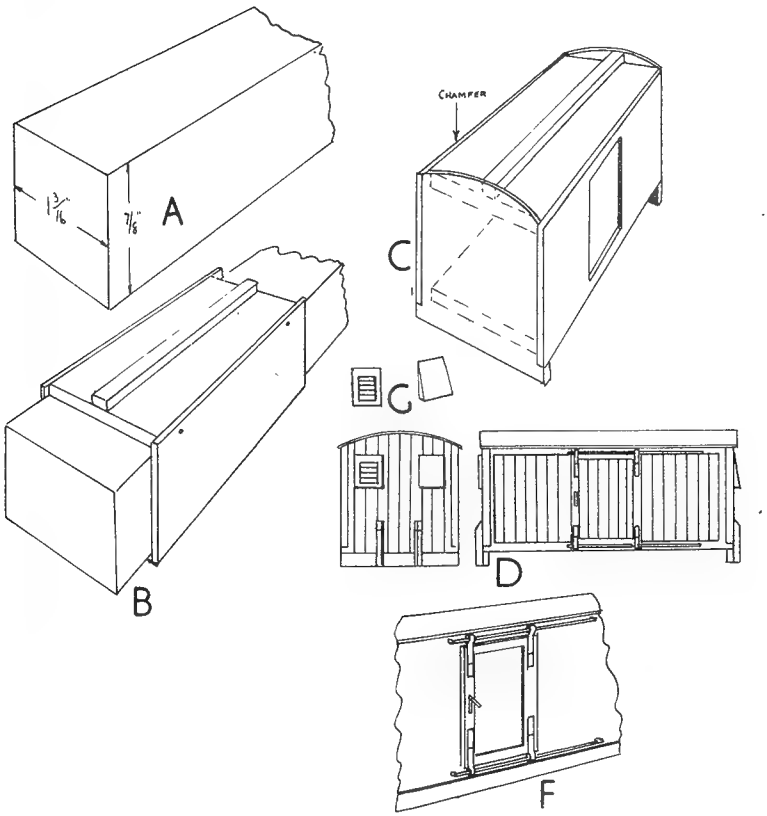


Fig. 2. VANS

around a rod and glued together. Made like this they will give no trouble in sticking to the edges of the sides and ends. This completes the body for a litho van.

There are several lithos for former company brake vans. We will take the L.N.E.R. type as an instance. The body-work for this type is rather more complicated, but very straightforward. At D (Fig. 3) we have top, base and two interior ends, the whole cut exactly to the requisite size of the papers. Pin and glue these as shown. Then add sides and ends as shown in C. This will leave small strips to be added as fillets for the corners of the ends, as well as along the top at the corners over the doors. These strips are glued in place as shown. For a litho van, of course, there is no need of the cut-out windows and doors of the interior

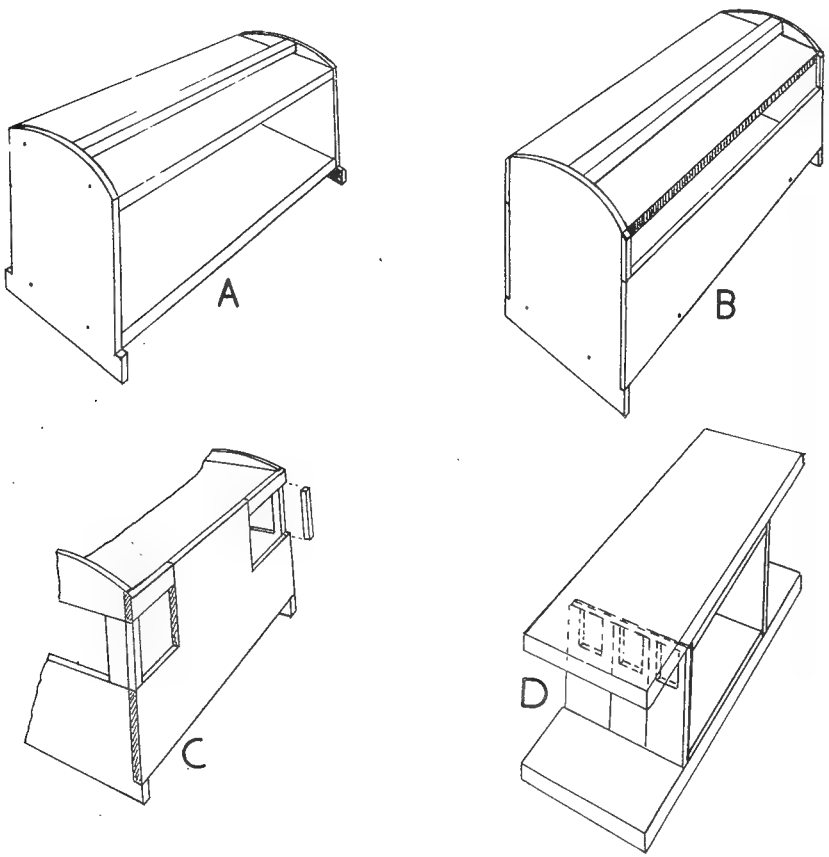
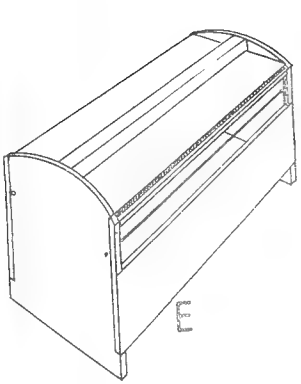
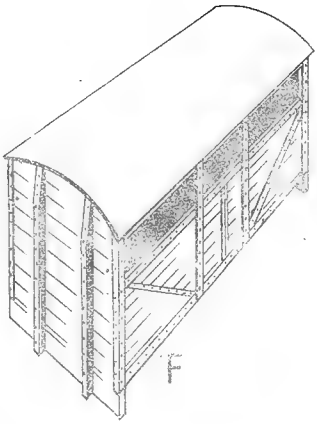


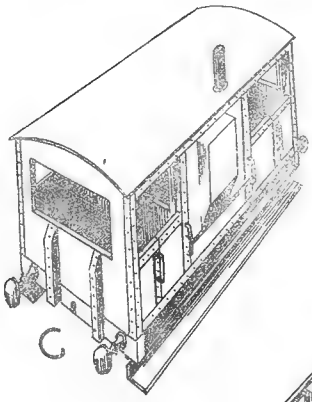
Fig. 3. VANS AND BOLSTERS

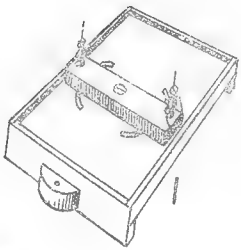
ends, though these can be added for a super-detailed unit. In that event, there will be the need of celluloid at the back to represent windows, and of an inset block door.

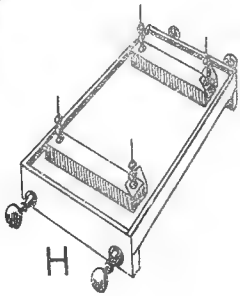
The litho sheets are glued on the woodwork, ends first, sides to follow. The under-frame is attached with two screws and the buffers through the headstocks. It is usually necessary to give the holes in the metal side-frames a slight clearance to ensure that they are drilled right through to take the buffers, or the buffer shanks may break off. It is also well to clear the journals for the axles with a $\frac{1}{16}$-in. twist drill held in the

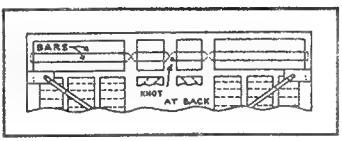












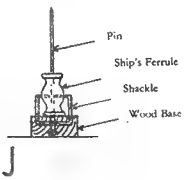


Fig. 3. VANS AND BOLSTERS

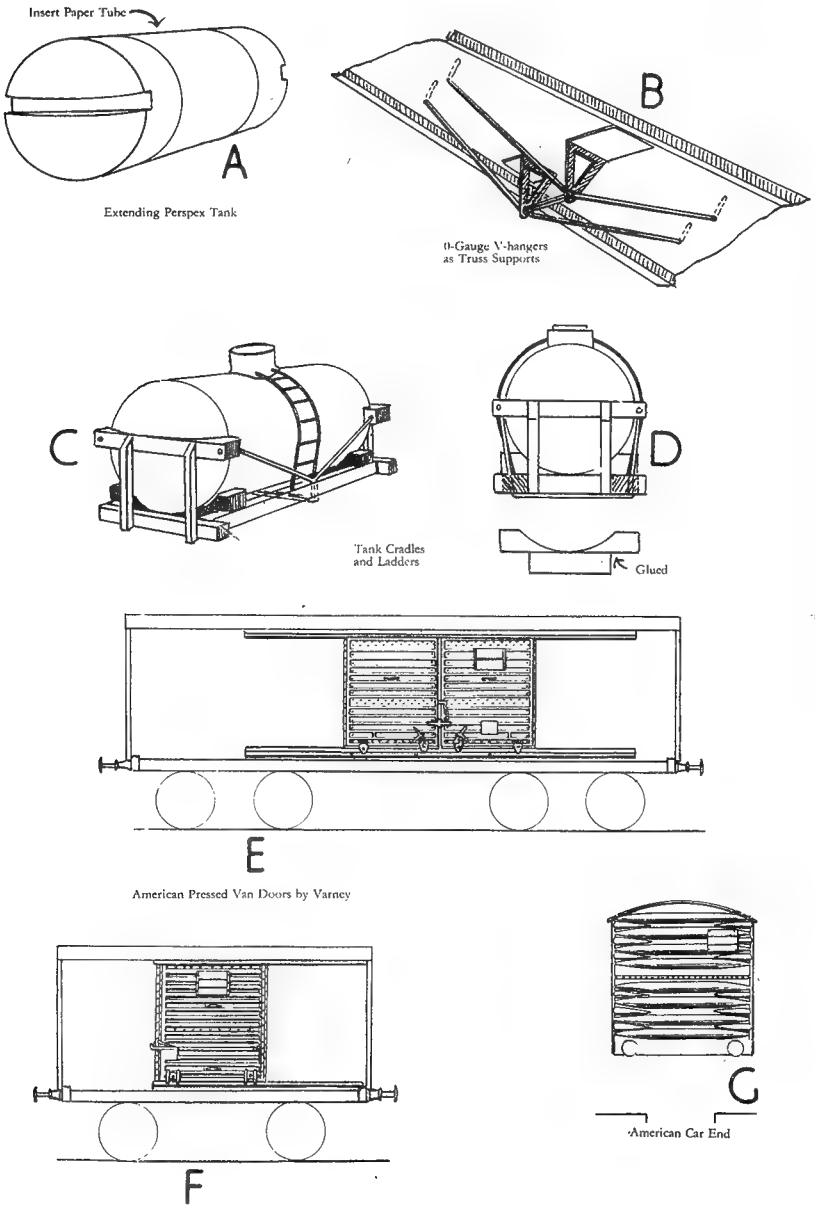
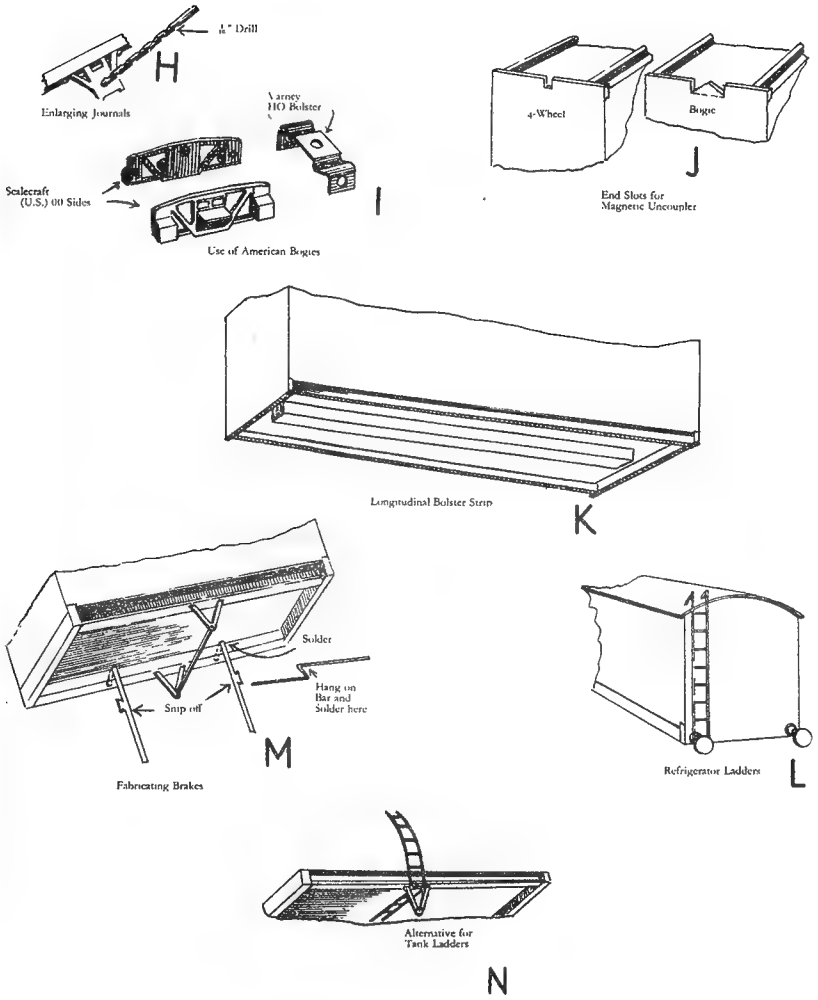


Fig. 4. USEFUL HINTS



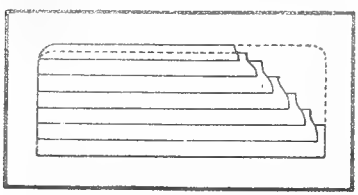
fingers (Fig. 4H). Do not be afraid of making a slightly loose fit. The whole of the under-frame and wheels should now be painted black. Brake vans will require steps, which can be had from any of the firms ready cut at about a penny each, and which are soldered, the top one (reversed with

its projected ridge downwards) to the ends of the metal side-frame, the lower one (right side up) to the base of the axle guards, having a piece of stripwood inserted to space it evenly from the top step.

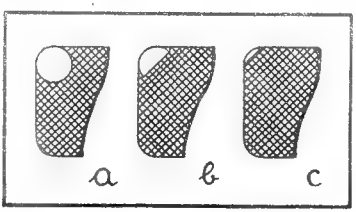
Other forms of super-detailing should be added to litho wagons. Strips of card can be pre-painted and fitted on for side struts on the bodies ; properly painted and riveted corner-plates can be added ; van corner-plates can be given to all vans. The interiors of brake-van ends can be painted to the body colour. Handrails can be fitted as for handbuilt vehicles, and proper end struts also fitted, painted to the body colours. The only detail omitted from litho wagons should be the indenture of the planking, and this is adequately shown.

HAND-BUILT STOCK

Before proceeding to the refinements of this work, we might well discuss the full range of commercial components available for the purpose. A large range of these are illustrated, and may be had for both 00- and 0-Gauge. Thus we have in Fig. 8 V-hangers and brake levers (Hambling) and side-frames by the same firm. In Fig. 8 we have also a Mellor chassis complete. Fig. 6 shows ERG buffers of the actually sprung type, while solid buffers may be had from Pritchard (Peco) and all the firms. The brass headstocks in Fig. 6 are an excellent feature (ERG) and have the enormous advantage of being ready cut for couplings. Wheels are an extremely important factor, and may be had in great variety and many qualities. In the writer's opinion, the best wheels are the brass ones, preferably oxidised so as not to require painting, and these should always be fitted on Peco insulaxles for present or future two-rail operation. Some excellent types are shown in Fig. 7, by ERG, Romford and Zenith, and admirable types are produced by Reidpath and Peco, the latter ready fitted to insulated axles. Similar axles may be had for 0-Gauge wheels, the firm of Rocket Precision making very superior wheels for this scale. Mention must also be made of the acceptable metal strip parts available

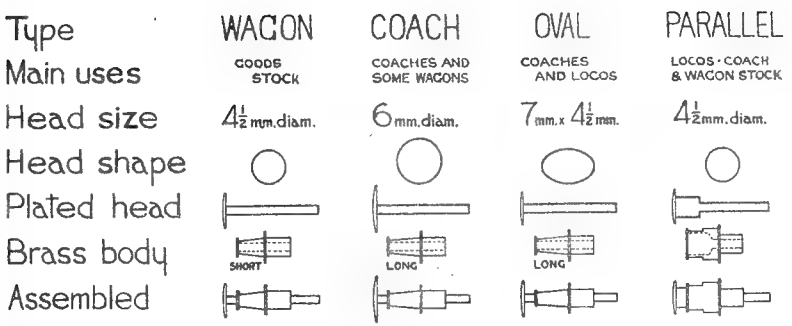


Making Louvres



Round Window Corner

Fig. 5

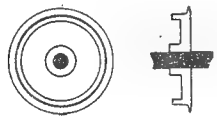


SPRING BUFFER TYPES (ERG)

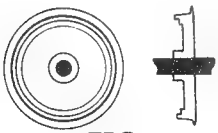
Type A : With correct holes for all ERG Spring Buffers

Type B : With correct holes for all ERG Non-Spring Buffers

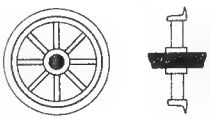
Headstocks (ERG) Fig. 6



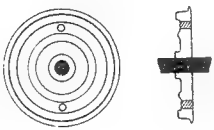
ERG
12 mm. Wagon



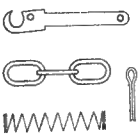
ERG
14 mm. Coach



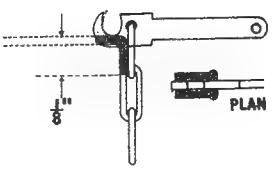
Romford
12 mm. Wagon



Zenith
18 mm. Gauge Coach



Scale Sprung Coupling (ERG)



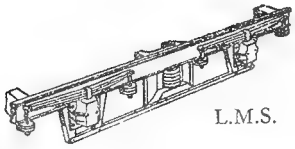
Non-locking Coupling Device

Fig. 7

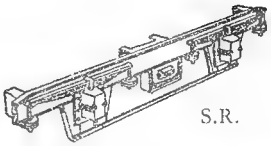
as a stock line anywhere, providing cut and riveted side struts, corner-plates for vans and opens, L-angle bars, steps, ladders and so forth, which render these items not worth the making by the amateur.

Let us revert back to Fig. 1, then, for a start in hand-building. The subject is an open standard wagon, to be produced in groups of, say, four at a time. This method is to be commended in that it ensures that all the wagons will be of identical size. Z is a sheet of thin plywood, about 1 mm. thick. This is first marked out with pencil at the thick lines for the cutting of the sides and ends. Next, the planks are scribed with exact precision and evenness, going the full length at one stroke. Use a pricker and thick metal rule, holding the former at a reasonable angle. The next step is to stick on the strips of adhesive tape (if this is chosen) to represent the upright strappings. Then the parts are cut out with a sharp knife or razor, the hatched parts being discarded. We now have the ends and sides for four wagons. In E we have a standard plywood floor as sold by Hambling. These should be at least $\frac{1}{8}$ in. thick. For special wagons other than the standard to suit the retailed side-frames you will require to cut your own from plain stripwood. Next proceed exactly as shown in A, B, C, as for litho wagons. D gives an inverted end section of the body dealt with so far. In F, things have gone a stage further; corner-plates, door straps and end struts have been fitted. K shows a completed end-opening wagon. The construction of end-doors to open I have several times described, but a series of diagrams should once again make clear how this is done. G and M give the salient points. In building the body, one end is left unattached and a separate headstock is fitted. Four tiny pin-holes are then bored in the plywood sides (positions described in K) to take the hinged door as at L. This door is fitted with a pair of pin-eyes, which should be driven into the edge of the door while it is held in a vice (N), the pins being then slightly bent over to an angle. A stripwood belt across the base of the door keeps it in place when shut, and the snib is a length of thin wire running across the lower extremity (M), each end being bent as shown. One end can of course be shaped before the wire is inserted. The two ends must be exactly synchronised in their movement. Side doors are simple enough. An aperture is first cut and a door fitted. The stout paper strapping is then arranged to loop about a wire hanger (formed from a pin) which is pushed well into the wagon base.

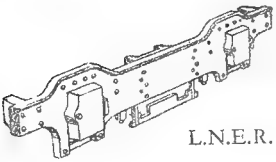
The work on vans is described in Fig. 2. Z shows a similar piece of plywood (which can be obtained from model aeroplane shops) marked out for vans as in the instance of the open wagons. D and E are the base



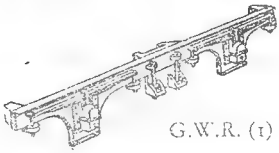
L.M.S.



S.R.



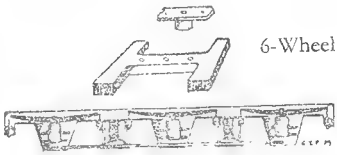
L.N.E.R.



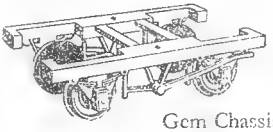
G.W.R. (1)

G.W.R. (2)

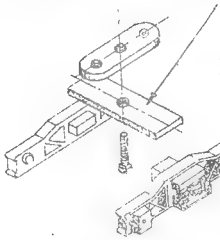
Hambling Coach Bogies



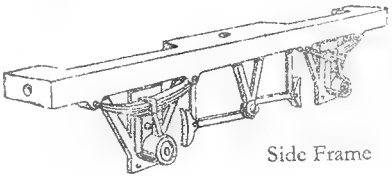
6-Wheel



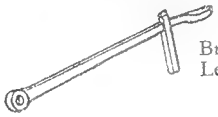
Gem Chassis



Diamond Goods Bogie



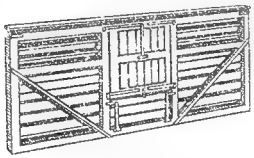
Side Frame

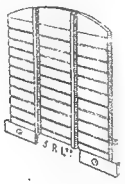


Brake Lever

Brake V-Hangers

Fig. 8





Cast Cattle Van by Reidpath

Fig. 9

and top. The work proceeds as with the litho body, with the added features of the scribing and detailing. Sliding doors are fitted as at D, E and F, an aperture being cut to suit, and the door being hinged by its strapping coiled double over a wire runner. These runners are fitted at top and bottom. End ventilators can be of the flat-louvred type or shaped from solid wood (G). Several diagrams of completed box wagons, including an L.M.S. refrigerator, are given at H.

Cattle vans are in construction much like a combination of the box wagon and open wagon. Proceed as at Fig. 3 (B) and fit the two short pieces of stripwood filling. Then add a ridge piece as in E. Additional upright fillets may be placed for the door posts and frames, and at this stage the bars can be slotted in if desired, the interior of the wagon first having been painted white. The exterior is then braced up with its required strappings, these wagons differing greatly in this detail. Mr. E. R. Gray in his handbook suggests a very useful idea for the fitting of cattle bars, which is illustrated (K). Here a strong thread or very fine wire may be used, care being taken not to pull it across the holes. The end struts are of wood, and these, as in all instances, may be covered over with riveted strapping if desired. Usually the lower plankings of cattle vans have apertures for ventilation, and on finishing the vehicle, the liberal run of white paint should be placed at these openings.

The sketch of the brake van (G) is self-explanatory, the construction having been described for litho vans. Handrails are fitted by shaping the wire and forcing it into holes pre-drilled with pins, using a strip of thin wood or card as a gauge, and withdrawing it when the handrails are fitted. The cross-rail is soldered while the gauge is still in place.

Bolster wagons, of which there are many types, are shown at H, I and J. These are more or less flat wagons with half-moon quadrants and pivoted or fixed bolsters. The wire shackles on the bolsters can be properly pivoted by using a small ship's fitting which slips over the vertical bar and is drilled to take the shackle. Bolts and nuts are best used for the pivots of the bolsters, the bolt-heads being countersunk flush down into the latter.

We have in Fig. 4 a number of expedients and hints for detailing various units. Dealing with tank wagons in 00-Gauge, it is worth mentioning that the miniature tanks made of polystyrene and sold with ERG "Masterpiece" kits are adaptable almost to any tank wagon usage. As supplied, they are too short for any but the standard wagon they are meant to build, and they will not take the lithographed tank covers as retailed by

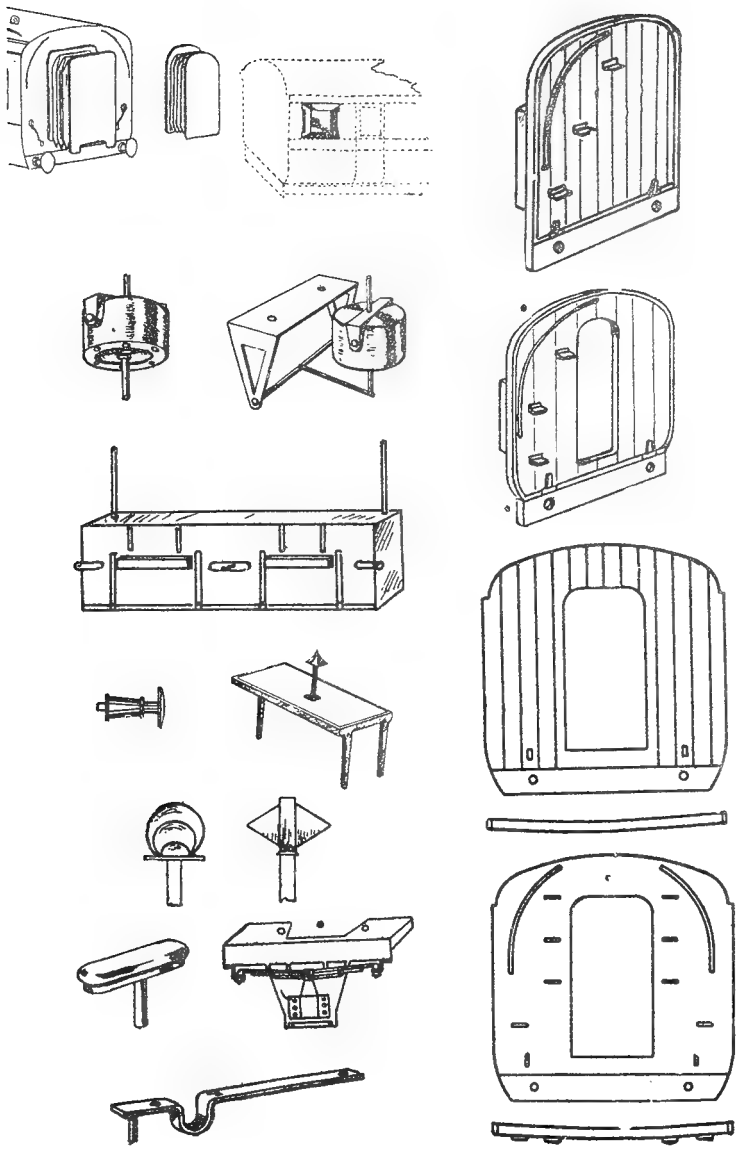


Fig. 10. HAMBLING COACH PARTS

Hambling. If other tank covers are desired, or if any other lettering is wanted, this will probably have to be drawn out and painted on some form of paper cover in any case. But fortunately, the " Masterpiece " tanks are produced in three sections, two ends and a centre. By discarding the centre piece and forming a fillet of Bristol board exactly to fit the tank, the latter may be extended to any desired length. The method is indicated in Fig. 4A. Further, if the position of the tank on its frame is slightly lowered ($\frac{1}{8}$ in.) it is possible to use the invaluable " Masterpiece " end retainers and struts, and to bring these right down to the bottom edge of the headstocks, as in C. An excellent pair of underbody truss-supports for a 00-Gauge bogie wagon can be made from two 0-Gauge LMC brake hangers (see B). C and D show various tank details. The polystyrene end retainers, sold by ERG, can be drilled and fitted with correct truss-bars, bent down into the wagon side-frames. Tank cradles are made from pieces of stripwood shaped as at D and glued up. They should be a tight fit between the side-frames. Tank ladders are formed from commercial stock, bent to shape and soldered at the base, being given a good inward spring which will retain them against the sides of the tank dome. A simple method, avoiding soldering, is shown at N. It may be mentioned also at this juncture that the " Masterpiece " oil tank can be extended to take the litho standard covers, or can be reduced to form a double-tank milk wagon as later illustrated. The use of certain American freight-car fittings for 00-Gauge British wagons is not to be disparaged, and instances are given in E, F, G and I of this procedure. Car doors can be reduced in height to suit bogie and four-wheel wagons of the freelance type, and metal car ends (G) work in admirably for British vehicles. The writer recently made up a set of excellent and unique bogies by using Scalecraft Vulcan type truck sides (for American 19-mm. Gauge) in conjunction with Varney HO-Gauge shaped metal bolsters. The bolsters are fitted to the sides by self-tapping screws, and these require a small washer to fill up the hole in the bolster. These washers were made from bent wire. The result was a set of four bogies of otherwise unobtainable design, of the equalised type, having Peco spoked wheels and insulaxles, as at I. Some details of brake rigging are given in M, that are particularly useful when dealing with " Masterpiece " under-frames which have only the V-hangers fitted when sold. It is easy to make brakes by using strips of brass shim ; I used a number of early flat brass brake hand-levers. These I bent at an angle, forced in between the side-frames and body and then cut off where shown. A piece of shaped wire was then soldered to the cross-bar and the

brakes completed. Refrigerator van ladders are best attached as at L, when the upper ends, correctly bent, are slipped into pre-made holes in the roof and the bases soldered to the buffer. A longitudinal bolster strip is often a useful item to fit, in order to raise the wagon height and at the same time to provide something akin to a solid truss under the wagon. The idea is shown at K. At J, we have methods of making slots for various types of couplers. With the new magnetic couplings the bogie wagon needs a wider slot than the rigid wagon. This is secured by cutting the ends in the manner indicated. At O, the arrangements for vacuum brakes are given.

Another important feature in building small wagons is that of providing sufficient weight for adhesion to the tracks, especially in open wagons. This can be done by screwing to the underside of the vehicle a rectangular piece of stout sheet lead by means of two very short screws, and it will make all the difference to the running.

In Fig. 5 will be found two ideas advocated by Mr. E. R. Gray in his handbook for forming miniature louvres on fish and fruit vans and rounded window corners where these are required both on goods and passenger vehicles. The louvres are merely strips of thin card superimposed at the edges, while the corner holes of the windows are pierced with either a saddler's punch, a tiny gouge or a shaped knife for the purpose.

It is extremely important in all wagon construction to ensure that the wheels when fitted are absolutely free-running and true. The slightest deviation from truth will cause any wagon to wobble and jump badly, and the slightest jar in running will tend to derail a whole train. Wheels should spin and continue to rotate at the touch *without oil*, the latter being only a subsequent aid. Therefore, do not be satisfied until every pair of wheels is right from the start. Jarring and locking often occurs for the simplest reason. A gentle out-turn of the axleguard, when fitted, with a pair of small pliers, done with care lest the guard breaks, will often put everything right.

Much has been written of couplers for 00-Gauge stock. In the writer's opinion there are only two wise alternatives; either use standard three-link couplings of the ERG type, or use the new H & N auto-magnetic couplings. A good idea is given by Mr. Gray and is illustrated in Fig. 7. Here the three-link coupling is provided with a pair of soldered wire retainers which effectively prevent buffer locking. But the magnetic uncouplers mentioned, and illustrated in Figs. 11 and 12, seems to be the very last word. Here, the appliance is almost entirely invisible, while the

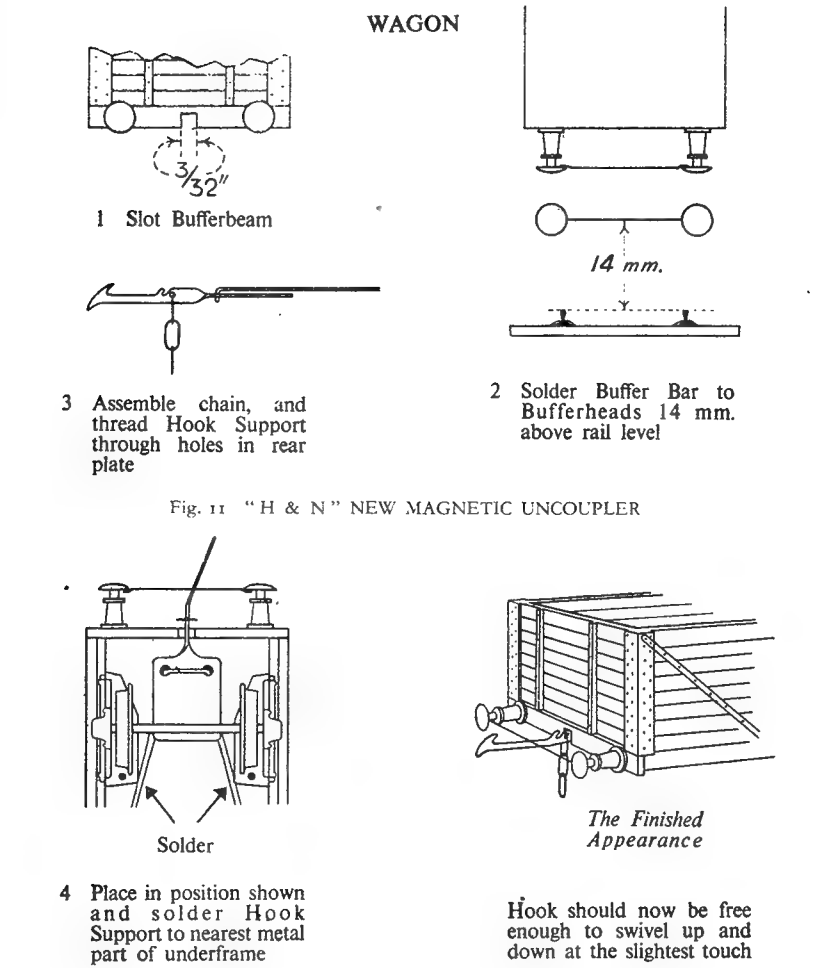

WAGON
3/32"
1 Slot Bufferbeam
14 mm.
2 Solder Buffer Bar to Bufferheads 14 mm. above rail level
3 Assemble chain, and thread Hook Support through holes in rear plate
Solder
4 Place in position shown and solder Hook Support to nearest metal part of underframe
The Finished Appearance
Hook should now be free enough to swivel up and down at the slightest touch

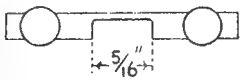
Fig. 11 "H & N" NEW MAGNETIC UNCOUPLER

Fig. 11

three links are there in evidence and form the crux of the appliance, yet no ramps of any sort are necessary, and the uncoupler can be either dead or alive at will.

Probably the best goods bogie obtainable in 00-Gauge is sold by Hamblings and is of the diamond-frame type (Fig. 8). This can be had

COACHES OR OTHER BOGIE STOCK



1 Slot Buff beam

2 Solder Buffer Bar as on Wagon

3 Assemble

4

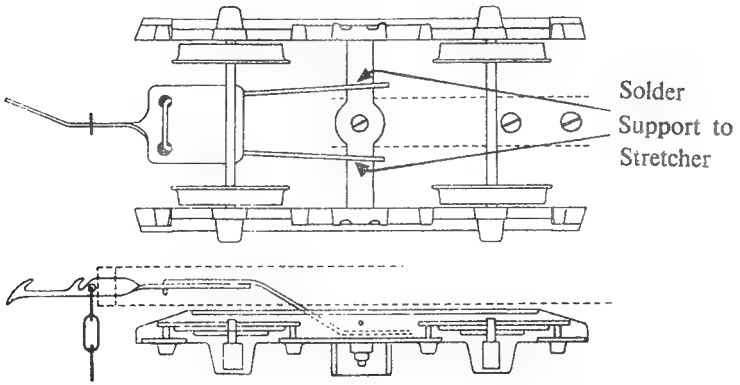
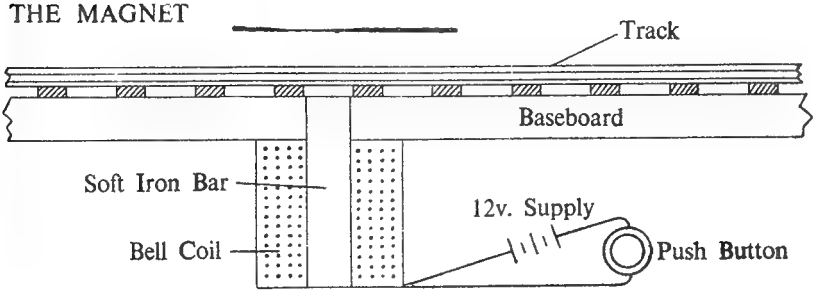


Fig. 12 "H & N" NEW MAGNETIC UNCOUPLER

THE MAGNET



in parts and is by no means difficult to assemble with solder. Do the work on a piece of thick plywood having an edging board nailed on one side, standing upright to form a rectangle. This will give you a reliable corner in which to set up the bogie, which is assembled with its wheels in place. You will soon become expert in getting the parts accurately and squarely assembled after a bit of practice. For 0-Gauge there is a larger range of bogies to select from, and these are usually sold ready made up.

OPEN WAGON BUILT FROM E.R.G. CARDBOARD PARTS

Apart, of course, from complete metal side-frames, it is often necessary to use individual axleguards on certain wagons where the wheel-base is longer. One of these axleguards is shown in Fig. 10. This method is also recommended where there is need of a six-wheel under-frame, and in all these instances it is necessary to build up separate brake gear.

I give several photos illustrative of work in handbuilt 00-Gauge wagons. One of these shows a Hulton and a Gresford wagon on Mr. Vacy-Ash's layout, another a group of vehicles built by the writer for the West Midland.

The fitting of wheels with Peco insulaxles is a task which can lead to a lot of irritation and wastefulness unless it is tackled correctly. At all events this was what happened with me, until a good friend made a wheel-gauge for me. After that I never had any trouble. The wheel-gauge (Fig. 40) is a precision job, and consists of two accurately machined blocks of mild steel which attach to each other by means of a pair of pegs. Each block has a half-groove to take the standard axle, and when slipped over the axle and locked together the two blocks from a gauge to fit exactly between the wheel backs. That is, the length of the combined block is 14.5 mm. I begin the work by detaching with light hammer taps the old axle from the wheels I want. Then, taking an insulaxle, I fit it over the holes in the wheels between the jaws of a small vice, taking care to get it straight all ways, and gently screw up the vice till I feel the axle slip through

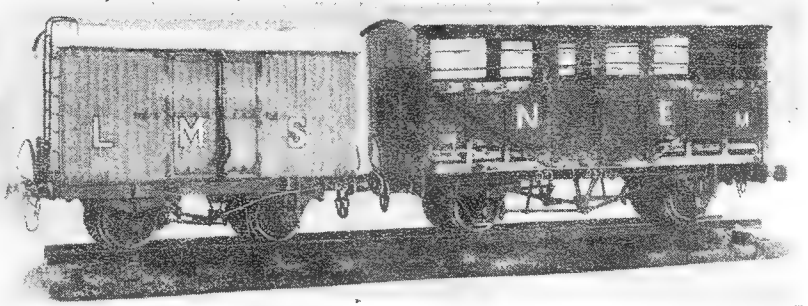
the wheels, and nip in the jaws. Then I take a Meccano collar, which is exactly suited to the purpose, and, opening the jaws, I insert this at one end of the work and force one wheel further by turning gently on the vice. Having used up about half the space between the gauge and the other wheel, I reverse the work and fit the collar over the opposite end, gripping tight until the gauge is flush. The work is then removed from the vice, the gauge disengaged, and the wheels are ready. It is almost impossible to bend an axle in this manner, and a hammer is never used on the fitting of the wheels. If it is it will certainly damage the ends of the insulaxles.

CONSTRUCTION IN METAL

If the worker is adept with a soldering iron there is a vast range of fascinating structural work when metal is used throughout in building wagons. Sometimes a certain amount of woodwork may be included, of course. Mainly this method applies best to hopper and special-purpose wagons.

In Figs. 14 to 17 a number of suggestions are given. Two hopper wagons of standard British design are shown in Figs. 14 and 14a, and they are much of a type although in outward form they differ. The Norman Jackson wagon is an excellent prototype and is just the thing for local coal traffic. It is, by the way, an all-black vehicle with white lettering. Several expedients may be adopted as alternatives for the forming of the body. The upper part may be soldered up from stout tinplate and attached to a solid wooden base to go between the frames of the wagon. Or, the whole body may be formed from tinplate, as desired. The side-struts are of axle-strip, and angle-brass of a minute size is used for the upper edging, being sweated, like the struts, on the sides. The solebars are of channel

CATTLE WAGON AND REFRIGERATOR VAN BUILT BY Mr. H. BRECH OF BREDA, HOLLAND, WITH GAUGED "PRECISION" CARD PARTS



PRIVATE OWNERS' WAGONS ON LAYOUT OF Mr. R. G. VACY-ASH

brass, and the end webs are of tinplate. The worker will find greater convenience in using improvised jigs for all such work as this, wood strips for gauges between struts, a wooden block around which to build up the under-frame, the work being executed on a thick piece of ply having one or two rectangular ridge pieces to expedite corner-making.

The L.M.S. bulk grain wagon in Fig. 15 is a much more difficult matter. For this vehicle, I think my own method would be to form the lower part of the body, shown shaded in the sketch, of wood, and the upper part in metal as before. But some may prefer to use metal throughout, as in the alternative diagram. The many rivets may be formed by tapping them out from the opposite side before assembling the work. For the side struts the tinplate angle-strip may be used, and the riveted strapping will work up with care for the corners. A difficult wagon to build, the design is very attractive when completed, and I would strongly recommend that parts should be cut to make up a set of three or four at one time, so that uniformity can thus be secured.

The marine boiler wagon, of which I have myself built several, is a rather different job. For this wagon I got a brass-founder to cut me pairs of sides to my own diagrams, with holes ready drilled for the binding rings. On these sides I sweated an edging where required of stout tinplate strip which was filed up neatly after soldering. Similar strip was used for the cross-members and diagonals which form the deck. Hambling's N.E. bogies completed the model.

For freelance enthusiasts like myself I would commend the two designs of Fig. 17. It will be noticed that they are designed for heavy traffic and that they include something quite novel in the way of bogies. These are, in fact, American HO-Gauge six-wheel and eight-wheel tender trucks, both designs being obtainable in America from Messrs. Dale Newton.

British-type wheels are substituted, spoked wagon wheels for the Gas Co.'s coke wagon and solid coach wheels for the ore wagon. In the case of the coke wagon invisible solebars are installed, while on the ore wagon these are of $\frac{1}{4}$-in. channel brass. For 0-Gauge there should be no difficulty in finding American trucks of similar design.

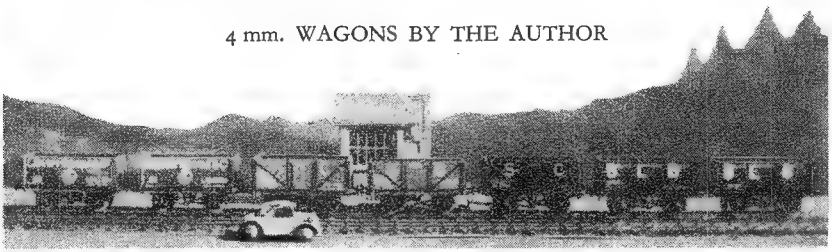
A most important point in all-metal construction is that the work should be most thoroughly cleaned up after soldering, especially if the outer surface becomes blotched with solder anywhere. This can be done quite easily, with patience, using a "four-in-one" tool especially designed for the purpose.

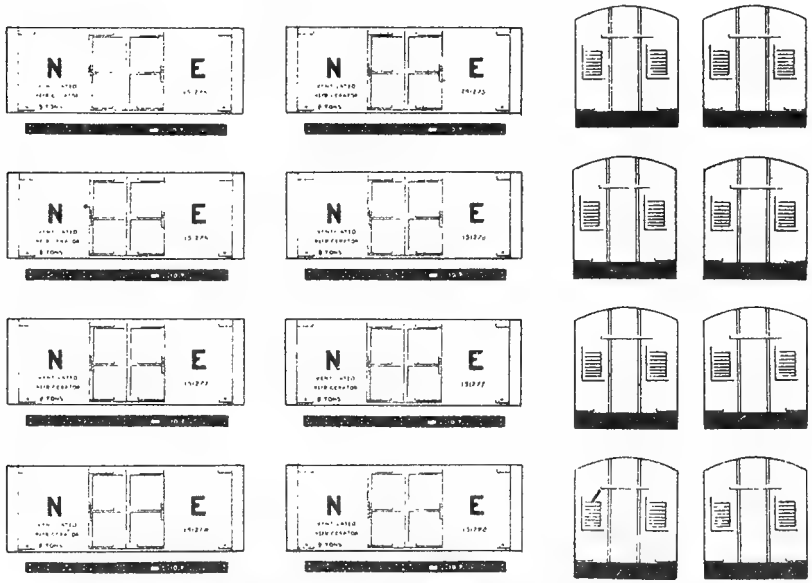
COMMERCIAL MODELS

It has always been possible to obtain excellent wagon work commercially, both in completed form and in kits, since the days when 00-Gauge and HO-Gauge came into being. One remembers some of the beautiful wagons built as far back as the twenties by craftsmen like Mr. L. C. Purchas and by Reidpaths, and it can hardly be said that the work then produced has been greatly superseded, though certain expedients and components have made unusual vehicles like tank wagons and slatted vans easier to build and more effective when built.

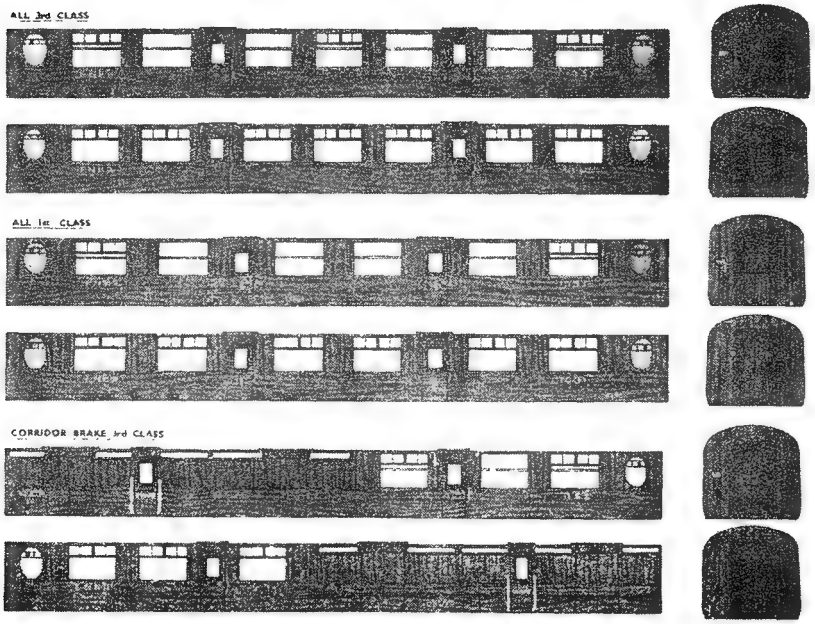
Among 00-Gauge wagon-building kits, suited to the amateur worker, there is perhaps nothing to beat the card sets retailed by E. R. Gray of Bournemouth. The method followed is illustrated in the diagrams in Fig. 18, which shows a kit for an L.M.S. cattle van. The sets are sent out printed on suitable card, with all details fully shown and drawn in. The task of the builder is to cut out the various apertures and recesses, with the strips for diagonals, and to glue these together according to instructions given. The designs are produced with considerable ingenuity and great faithfulness to prototype, and some of the models constructed from these sets which I have seen are exceedingly effective, a good deal, of course, depending upon the skill of the worker. The value of the scheme would

4 mm. WAGONS BY THE AUTHOR



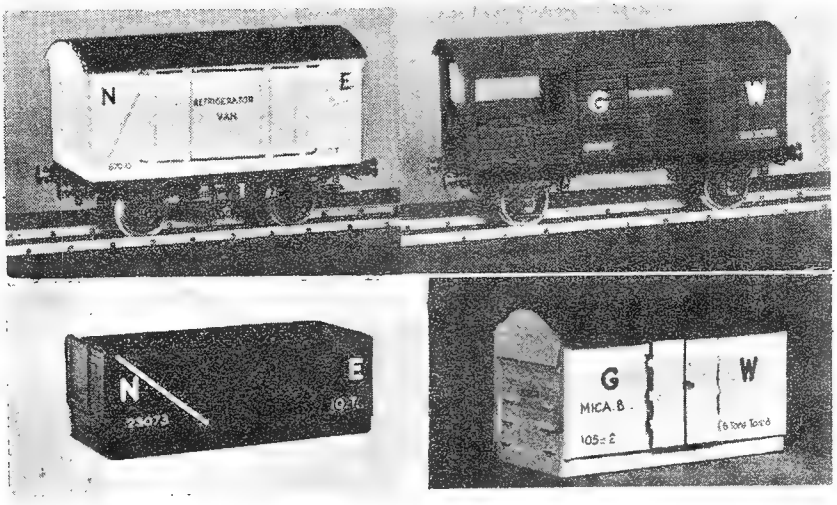


Four N.E. Ventilated Refrigerators



L.N.E.R. Steel Corridor Coaches—Post War Type

Fig. 13. TYPICAL HAMBLING LITHO SHEETS



WAGON BODIES BY WALKERS & HOLTZAPFFEL

be enormously enhanced if the times were not quite so wantonly obstructionist, so that proper tools for cutting and working could be obtained. Visitors to America, or those who have friends there, might endeavour to obtain an Exacto set of cutting knives and they would be perfectly equipped for the work. Failing such equipment a very sharp pocket knife will do the work, but it must be kept sharp. By the use of these parts, as will be obvious, the need for scaling down and drawing out the scale designs is entirely dispensed with. The range already includes open wagons, cattle vans, brake vans, fish, hoppermilk, fruit and utility vans, there being a goods brake design for each of the pre-Government groupings. One or two photographs, kindly supplied by the manufacturers, will serve to show the excellence of these models when carefully completed.

While speaking of cattle vans, mention must not be omitted of the beautifully moulded metal body parts for a standard vehicle of this type produced by Stewart Reidpath Ltd.

A very fine range of finished wagon bodies, completely painted and lettered, is on sale by Walkers & Holtzapffel Ltd. of Baker Street. Among these will be found almost every type of standard British wagon, the workmanship of which is extremely good. The price of these is reasonable for finished work, though unfortunately there are one or two slight slips

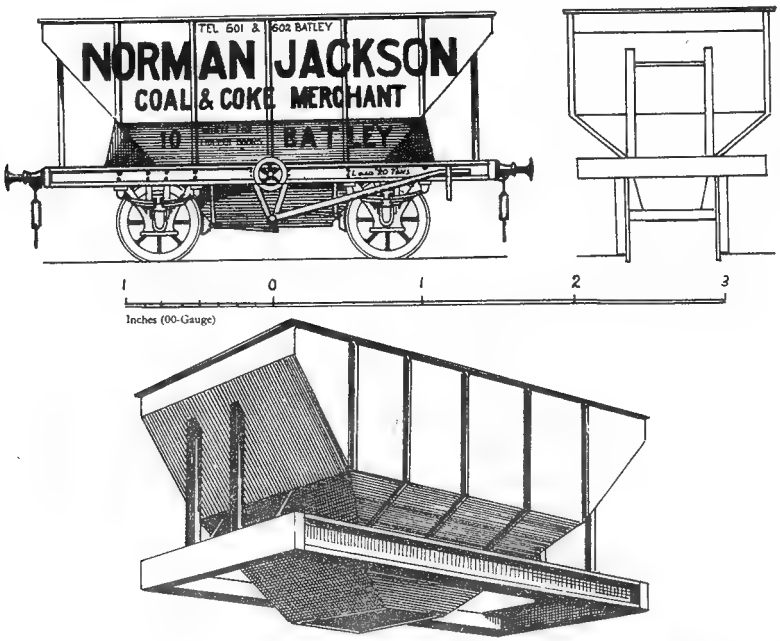


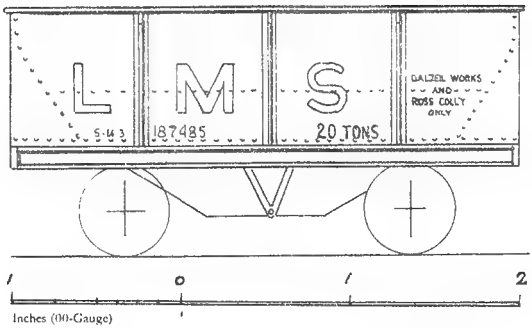
Fig. 14
P.O. COALHOPPER

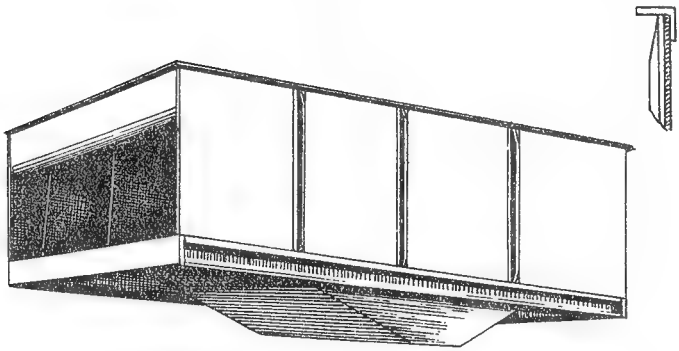
in the positioning of the letters in some instances, particularly in the instance of N.E. stock. An added feature of the series is that many are produced with opening doors, both on vans and open wagons.

The " Masterpiece " sets of wagon parts in metal and polystyrene are also to be recommended, their only defect apparently being that the brake gear on the chassis is not sold complete. It is, however, an easy matter to complete this in the manner already described. A particularly excellent feature is that of the wheels, which are unique in that they have metal rims and plastic spokes and hubs, ensuring both perfect insulation for two-rail and perfect running. The method of assembly being standardised renders it impossible to fit the chassis together so as to involve any kind of wheel-lock or running jar. The series includes flush-door vans, hinged-door vans, all-steel mineral wagons, all-steel coal wagons, vans with sliding doors, low- and high-sided opens, a tank wagon and a brake van.

Messrs. A. W. Hambling also produce finished wagons to customers' requirements and turn out some first-class work.

Fig. 14a
L.M.S. HOPPER





STANDARD DESIGNS

It is probable that under Government control the varieties of wagon designs will not be so plentiful as heretofore, nor will the lettering of wagons make such a demand on skill as with the earlier companies and groups. It must be remembered, however, that for many years the existing wagons on the roads will remain in evidence and will for some time retain their individuality, while models of earlier types and of those existing today will before very long possess an added value and interest. Under the new regime, it no longer remains necessary to embellish rolling stock with any company initials, and in the new orders for the lettering of wagons there is no provision for any owners' marks. The earlier groups, however, retain their identity in the prefixed letters attached to the numbers, and in the chart (Fig. 19) the representative details are fully given.

There can be no attempt in a small handbook of this order to enter deeply into the standard designs. The builder is recommended to obtain a blue-print from any of the firms who sell them—Skinley, Edwards Bros., Bassett-Lowke, Hambling, Gray, Bonds and others—of the particular

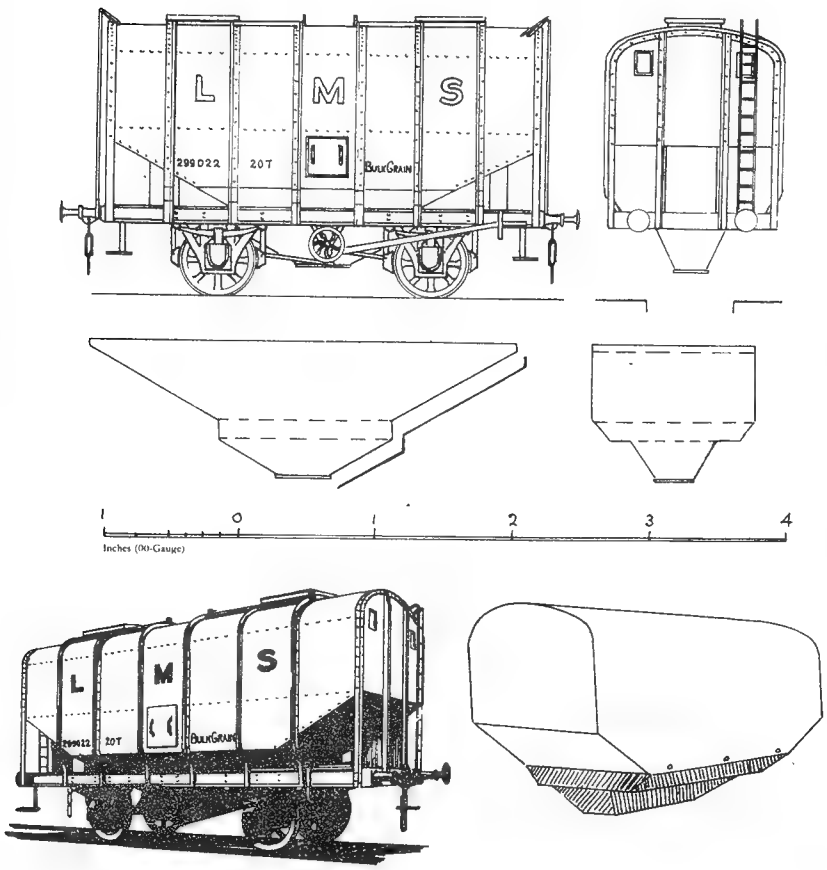


Fig. 15. L.M.S. BULK GRAIN WAGON

vehicle to be modelled. A few designs are given here merely in order to impress the beginner with an idea of the wide field of selection and to commend one or two desirable types. The twin-tank milk wagon in Fig. 20 is unusual and attractive in that it is a six-wheel vehicle and has two tanks. Fortunately these tanks can be modelled with the greatest simplicity by using a couple of " Masterpiece " 00-Gauge tanks deprived of their inner sections, and covered with cartridge paper, coloured, on which the lettering can be inscribed. The advantage of these tanks is that they are provided with grooves for the end struts and correctly shaped extremities. Some details of construction are included in the figure. The

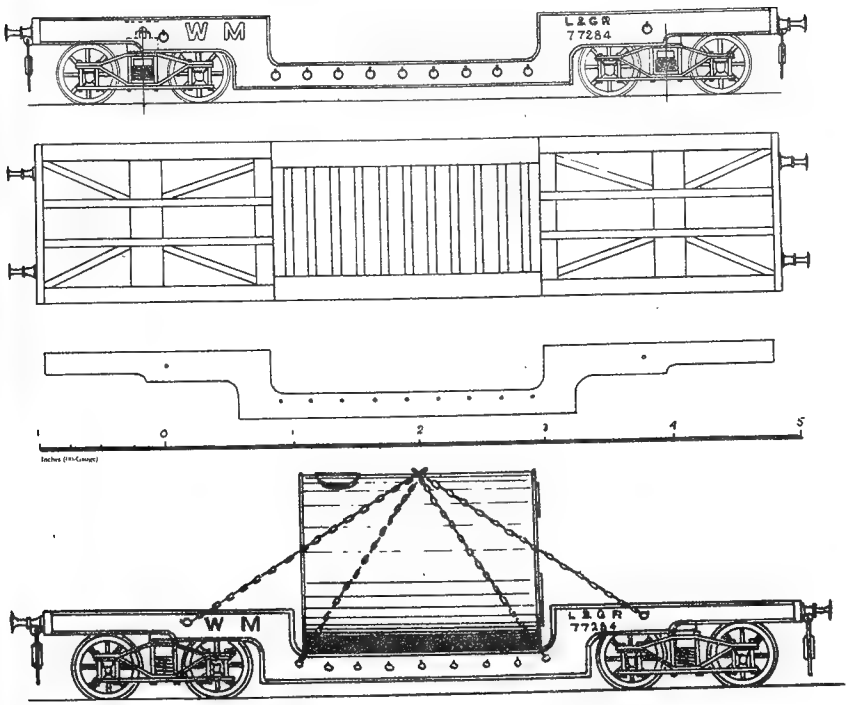


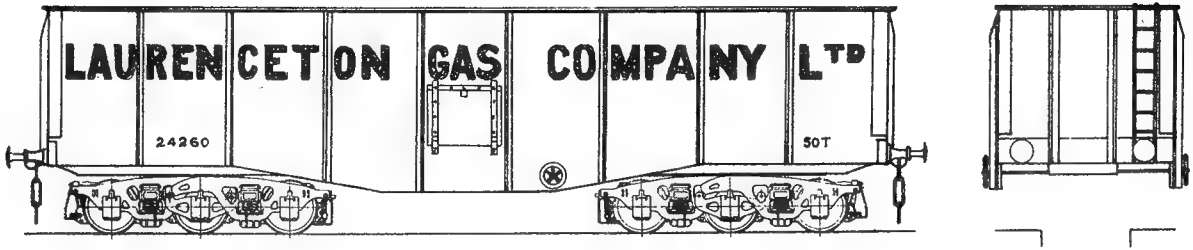
Fig. 16. N.E. MARINE BOILER WAGON

specially shaped end-struts can be cut from thin wood. Hold-down stays and bands are made from stripwood and Bristol board. The under-frame has channel solebars to which individual guards are soldered. Note the solid wheels.

The cattle van and standard covered van in Fig. 21 are interesting units in their respective classes, while the L.M.S. open wagon and container flat in Fig. 22 give the main features of their types. For the designs in Figs. 23 and 24 I am grateful to the editor of *The Model Railway Constructor*, and in Fig. 25 I have given two designs for special-type wagons which will offer variety to the builder. A "mixed traffic" van and a bolster wagon (Fig. 27) complete the series.

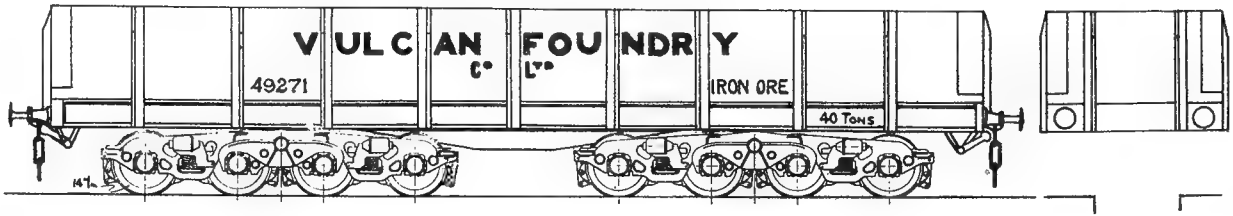
PRIVATE OWNER'S WAGONS

In Fig. 26 will be found four designs by Mr. W. F. Bolton, for which I am indebted to *The Model Railway News*, and which will serve to show the enormous variety to be found in the common open wagon, not only as regards lettering but as attaching also to every detail of their design.



STEEL COAL WAGON

Inches (OO-Gauge)



STEEL ORE WAGON

Fig. 17. FREELANCE HEAVY STEEL WAGONS

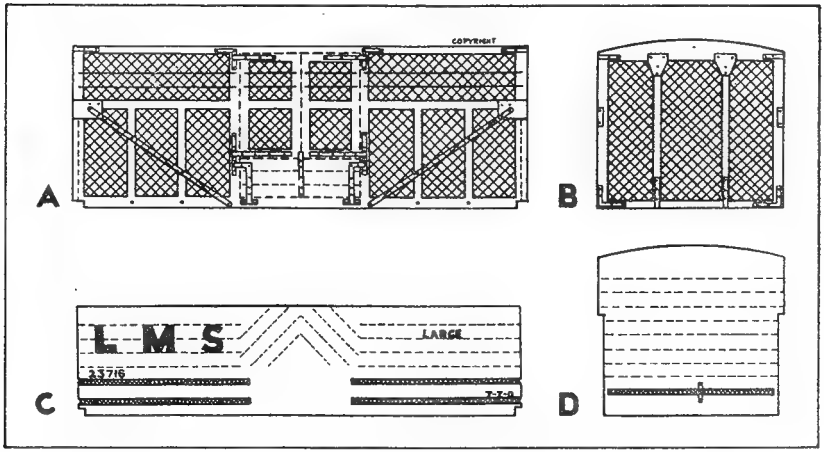


Fig. 18. TYPICAL FORM OF "ERG" WAGON CARD PARTS

Private owners' vehicles will always be popular if only on account of the variation in their colouring and finish. The Evans & Bevan wagon is black (or practically so) with white lettering, the Silk, Denaby and Fife wagons are red oxide with white letters shaded black. Further selections are given in Figs. 29 and 30. First we have a set of typical Scottish wagons with their various colour details, followed by a similar set of English designs with theirs.

This brings us to the subject of wagon lettering which is almost a handicraft in itself. The beginner should not despair if it takes him a considerable time to produce anything decent in this connection. There are also various aids to the work, such as transfers, some of which are highly useful. But when once the art of hand-lettering is mastered the worker will never again resort to the latter, for their range is very limited and few kinds of transfers are reliable enough not to involve considerable waste. Whereas when one is lettering in water colours it is the simplest matter to erase an error with a touch of clean, damp cloth.

I have found the best method of lettering to be that of using an ordinary mapping pen. I work always with a powerful stand magnifier, a book on which to rest the wrist, an egg-cup full of clean cold water and a bottle of fairly stiff water colour. In the plotting out of the main letters I use no guide other than the planking and the number of letters in each of the three sections (or more) of the vehicle side. The whole art of getting the colour to run correctly lies in dipping the pen in the water.

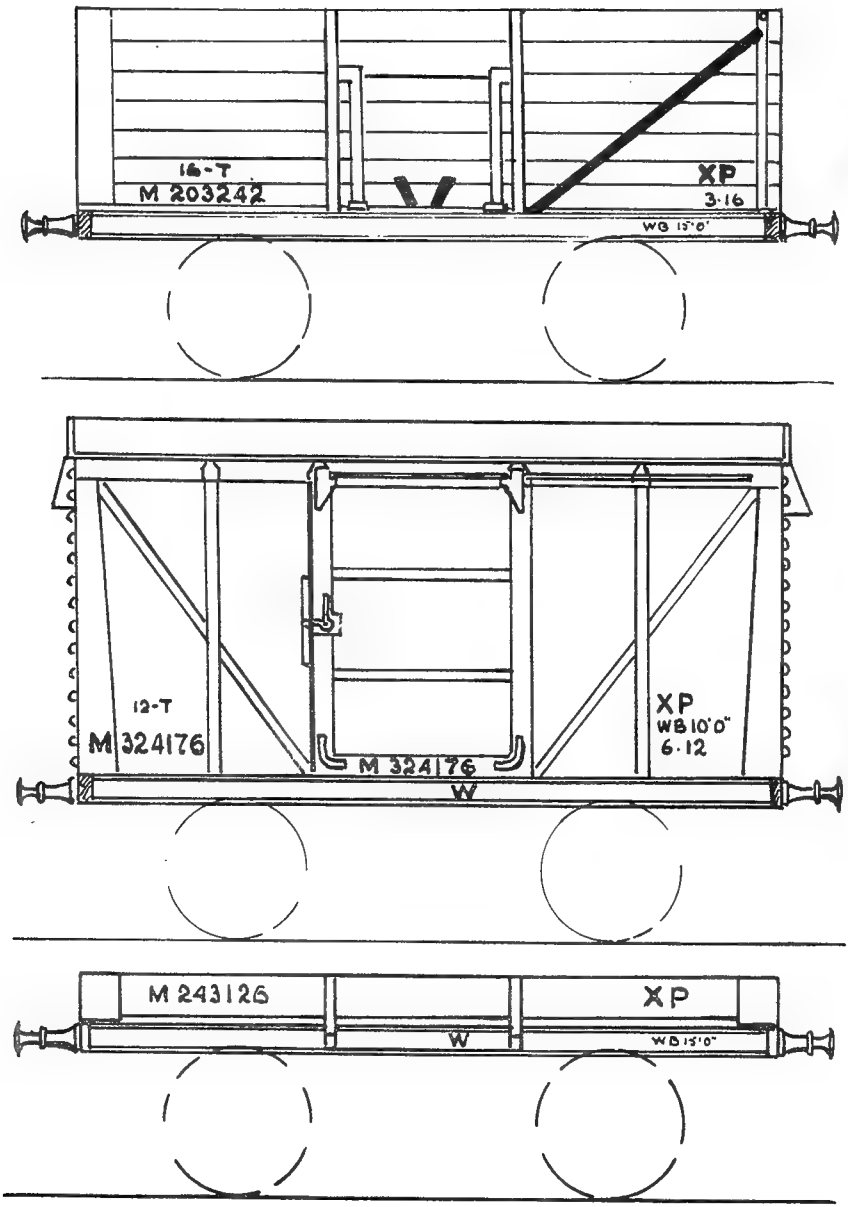


Fig. 19. B.R. WAGON LETTERING

Gill Sans Medium letters thus :

A B C D E F G H I J K L M N O P Q R S T

U V W X Y Z 1 2 3 4 5 6 7 8 9 0

a b c d e f g h i j k l m n o p q r s t u v

w x y z

Number Prefixes :

B for new wagons
„ for ex M.O.T. wagons
„ for ex M.W.T. wagons
E for ex L.N.E.R.
M for ex L.M.S.
S for ex Southern
W for ex G.W.R.
D. for service wagons

Colours :

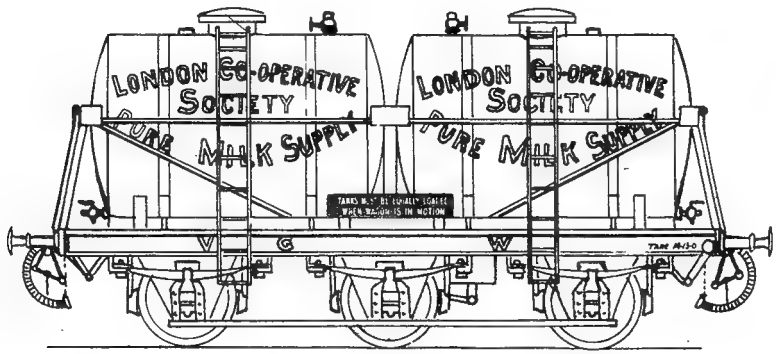
Dark Grey : unfitted
Orange Brown : fitted
White : Insulated
Stone : Insulated meantime

Black letters on insulated stock

Fig. 19. B.R. WAGON LETTERING

Into the water the pen is dipped every time it is used, after it has been dipped in the colour ; and in dipping into the water, only about one-eighth of the point is submerged. Too much paint must not be picked up at one dipping. First, then, the sides of the letters (vertical) are drawn, then the horizontals are drawn in with a ruler. Then the body of the letters is filled in. Smaller letters are drawn freehand. If a circle is required, as in the instance of the Gibson, Whale wagon, it is drawn in with compasses, the pencil mark being the basis of the painting. If the wrist is resting at a level with the surface of the work, there is really very little difficulty. For white, use process white ; for colours, use water tints in tubes.

For the painting of wagon bodies, use oil paints of the exact hue, to be had from model manufacturers, such paints to be guaranteed flat-drying. Do not use oil paint that is more than a year old, or to which turpentine has been frequently added. Apply one coat only, or the second coat will dry shiny. Paint open wagons with diluted permanganate of potash or weakened Indian ink inside ; do not use paint for this purpose.



G.W.R. DUPLEX MILK TANK WAGON

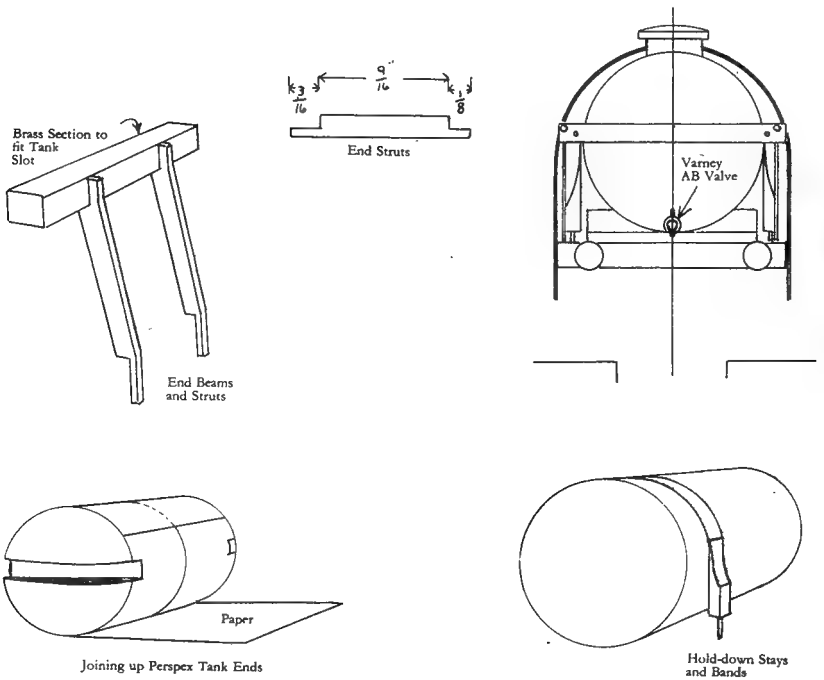


Fig. 20. TWIN-TANK MILK WAGON

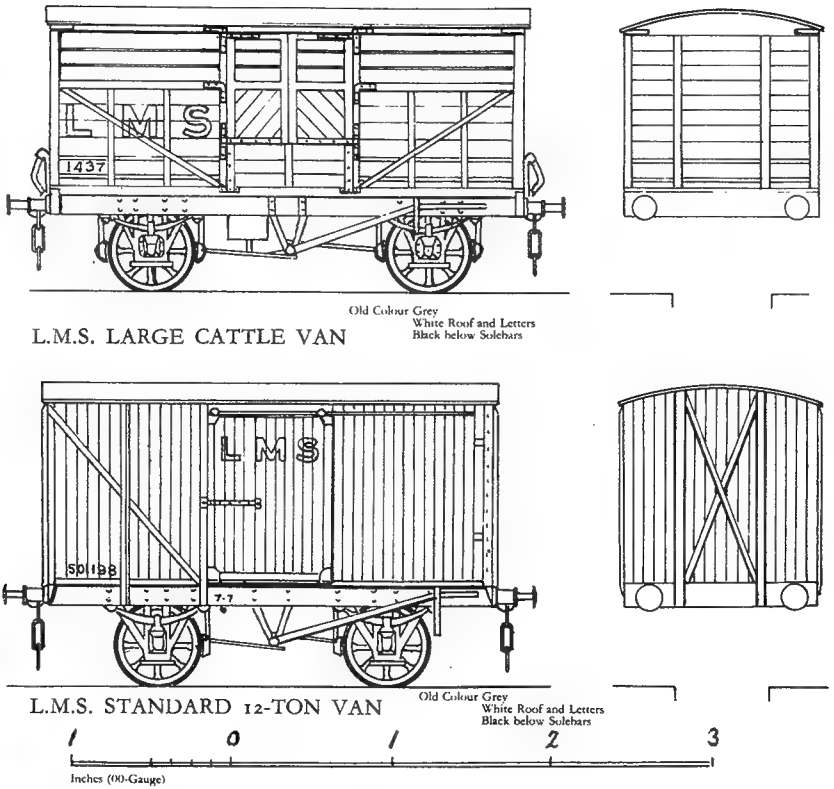


Fig. 21

One advantage, by the way, of " Masterpiece " plastic wheels is that if you paint their backs you have no need to paint the spokes, for the black shows through.

When the lettering is done and dry, take a perfectly clean brush and coat the entire surface of the wagon, sides and ends, with Fixative (not varnish), again one coat only. This will preserve the letters from rubbing off for any length of time.

SHEETED WAGONS AND LOADS

Small-capacity common wagons are frequently used in duplicate, triplicate, or even in sets counting up to four and five, for the purpose of carrying bulky and heavy loads of timber and so forth. Such a load appears most convincing and attractive in miniature provided that it is correctly

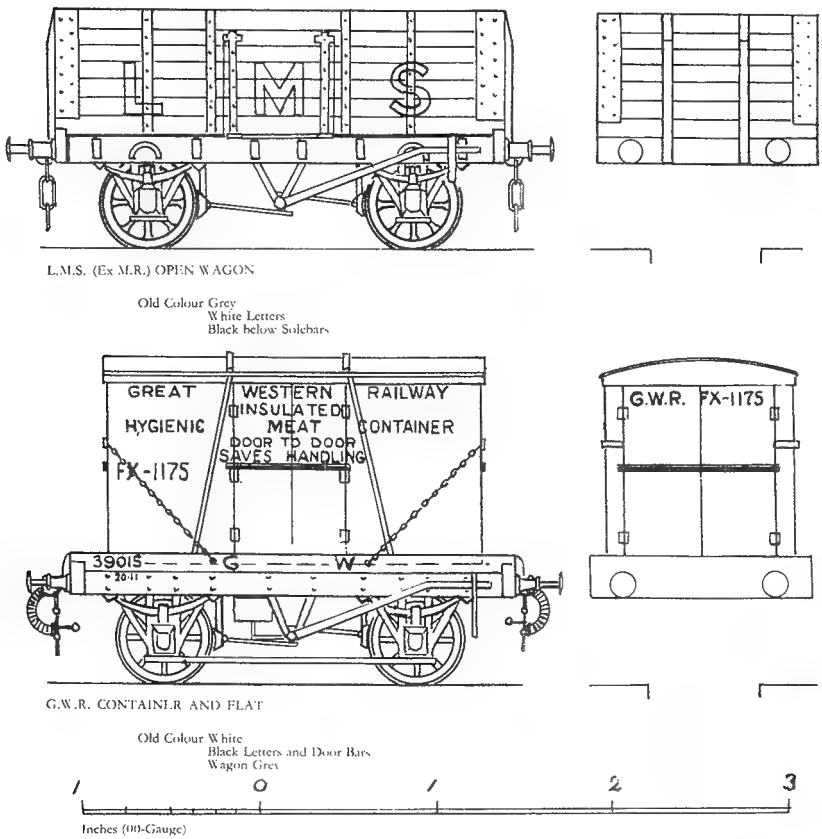
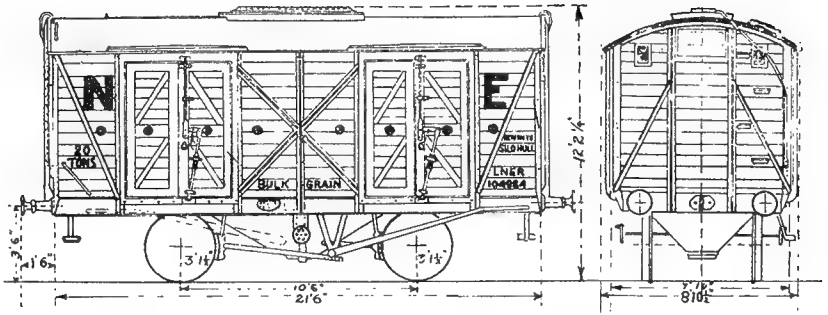
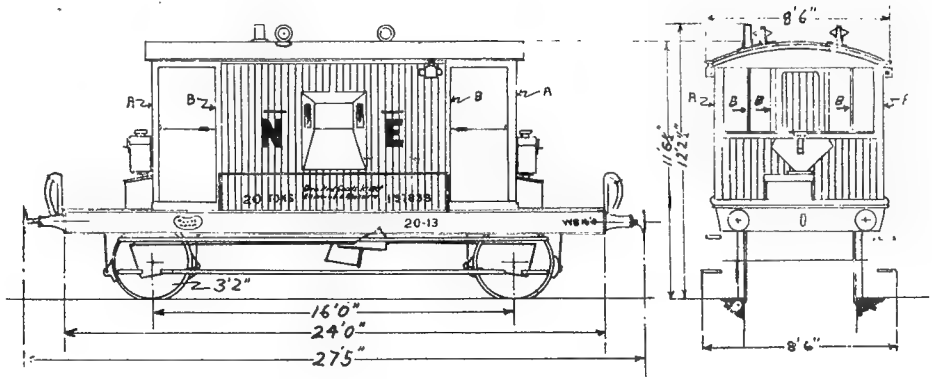


Fig. 22

adjusted and attached. There will be found in Fig. 28 a number of diagrams depicting various arrangements of timber, tubing and girder freights. In A, we have a two-wagon set for heavy baulks of timber with a match-truck to clear the projecting ends. In such an instance, the bolsters would be removed from the match-truck, and the load would be "chained free of wagon" near the projection. Other chains would be attached over the load to the bolster shackles, the bolsters, of course, being of the swinging type. B shows a three-wagon arrangement with the match-truck placed in the centre, the free chaining being over the centre wagon. Note, however, that in the case of telegraph poles or other flexible timber loads (E), the bolster would be left in place on the centre wagon.



L.N.E.R. 20-TON BULK GRAIN VAN



L.N.E.R. 20-TON BRAKE VAN

Fig. 23

Inches (00-Gauge)

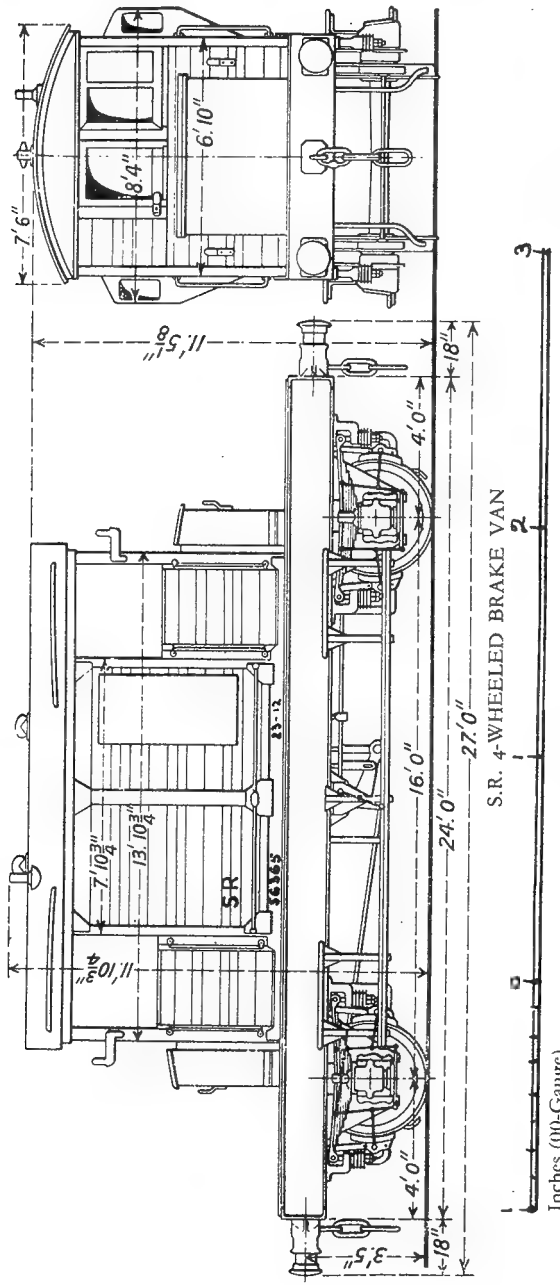
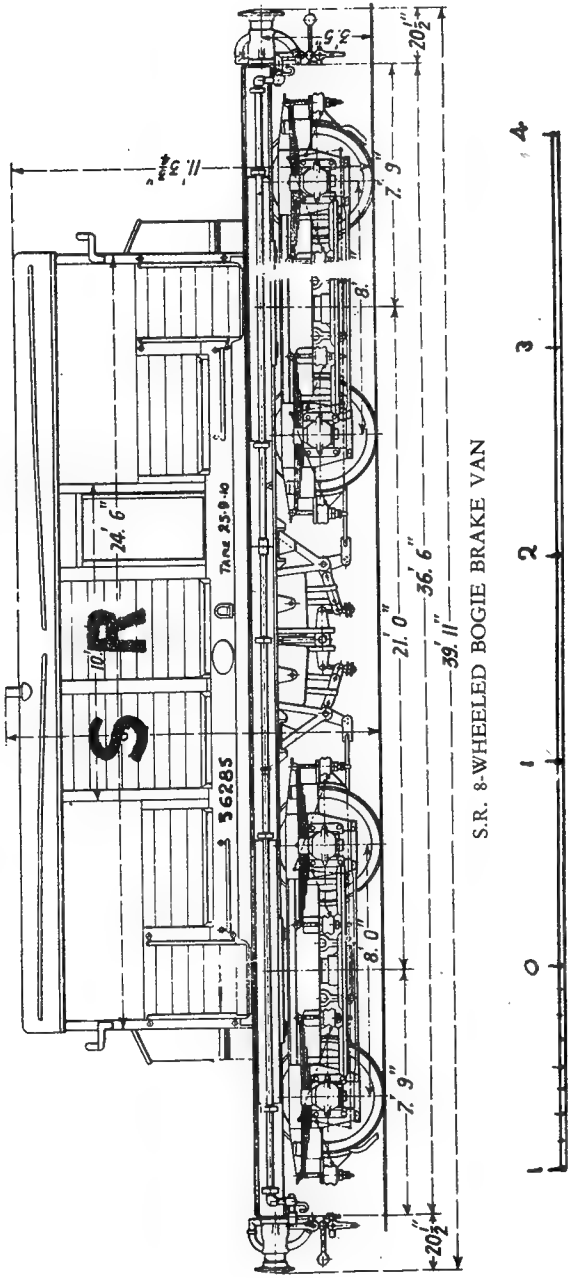
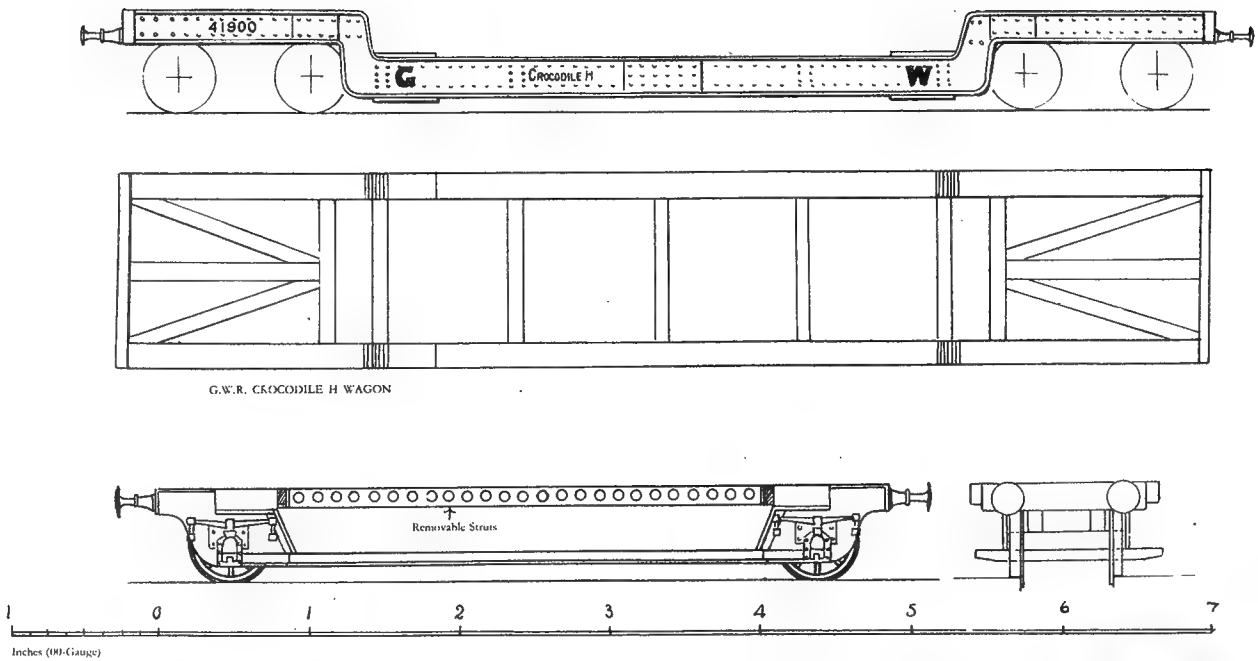

7'6"
8'4"
6'10"
11'5⅛"
18"
4'0"
16'0"
24'0"
27'0"
4'0"
18"
3'5"
11'10¾"
7'10¾"
13'10¾"
S.R.
56365
S.R. 4-WHEELED BRAKE VAN
1
2
3
Inches (00-Gauge)

Fig. 24



S.R. 8-WHEELED BOGIE BRAKE VAN

Fig. 24



G.W.R. CROCODILE H WAGON

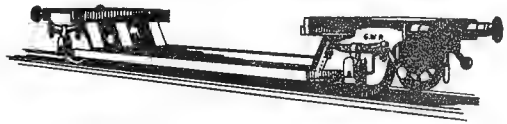
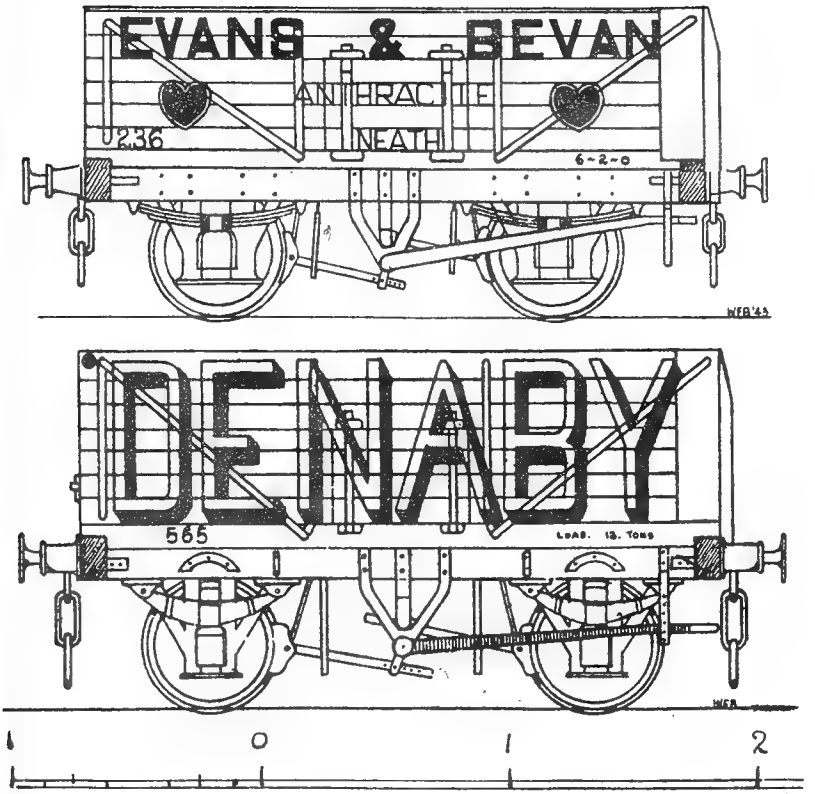


Fig. 25. G.W.R. EXCAVATOR WAGON



Inches (00-Gauge)

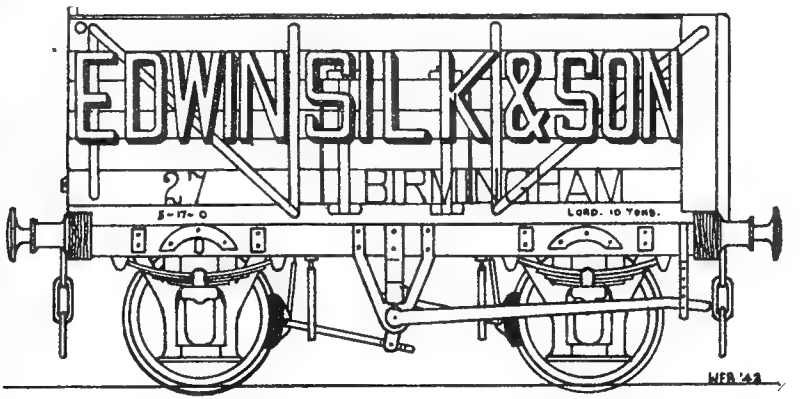


Fig. 26. PRIVATE OWNERS' WAGONS

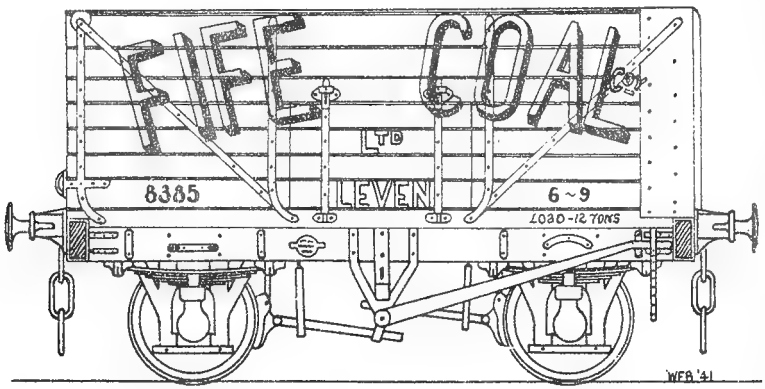


Fig. 26. PRIVATE OWNERS' WAGONS

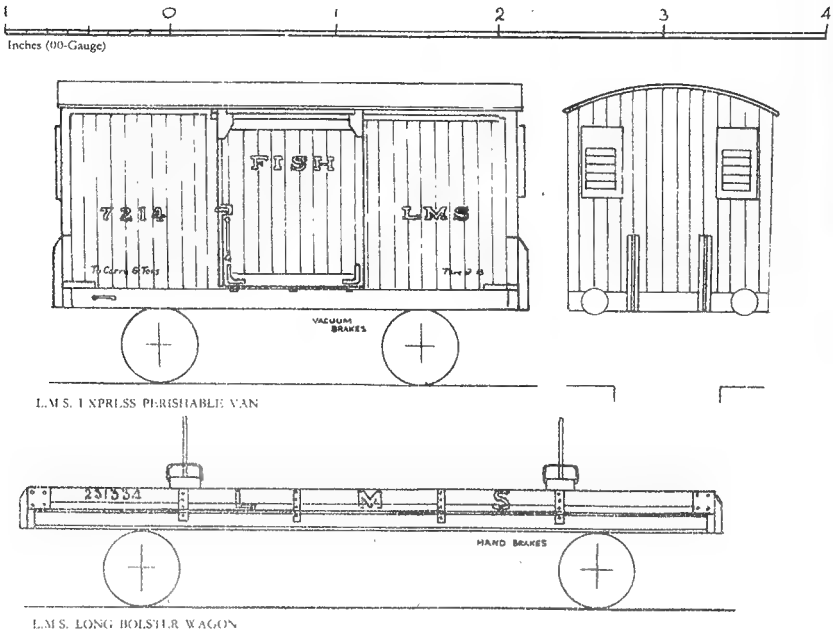


Fig. 27

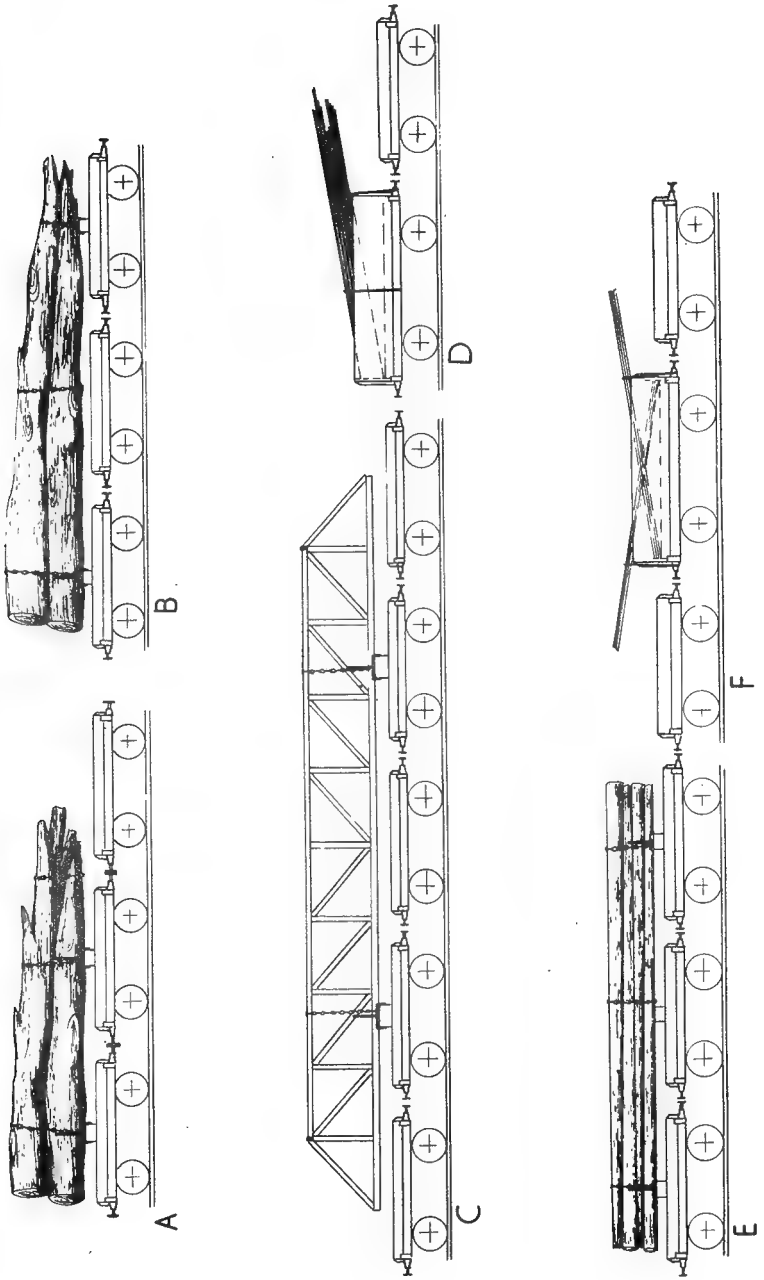
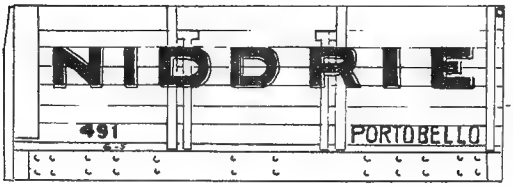
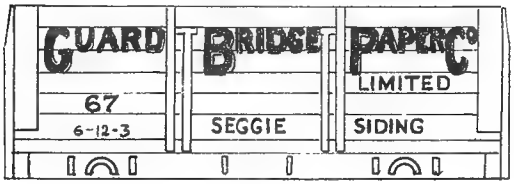


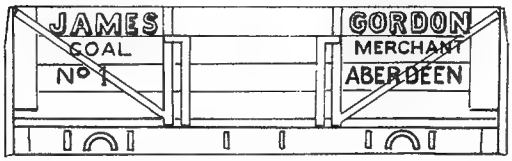
Fig. 28



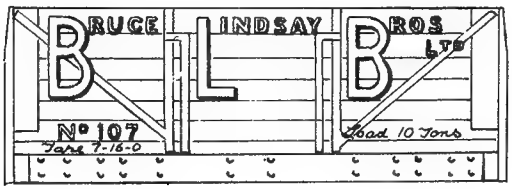
Grey
White Tyres and Writing
Black Iron and Shading



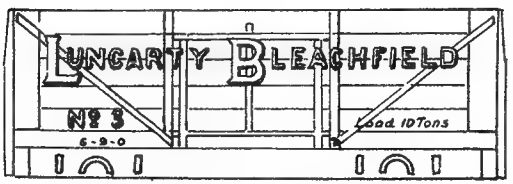
Light Grey
White Tyres and Writing
Black Ironwork
Shading Red or Black



Lead Grey
White Writing, Tyres and
Brake Lever End
Iron and Shading Black

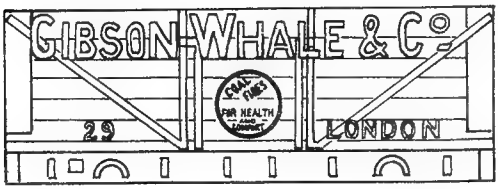


Dark Red
Black Iron and Shading
White Writing and Tyres

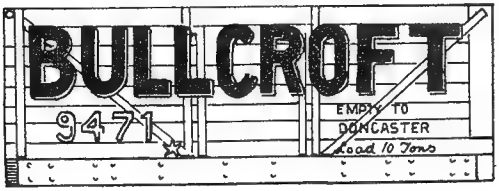


Dark Red
White Tyres and Writing
Black Iron and Shading

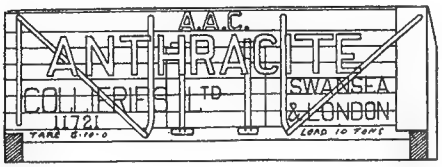
Fig. 29 PRIVATE OWNERS WAGON LETTERING
(Scottish Wagons)



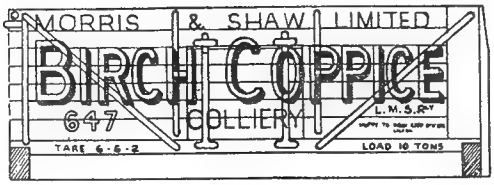
Grey
White Letters
Black Underframe



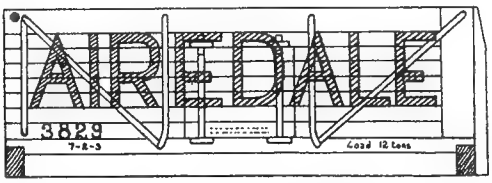
Red
White Letters and Headstock End at Opening end
Black Cornerplates and Shading



Black
White Writing



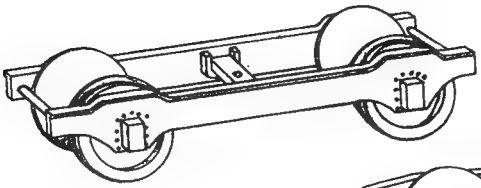
Red Oxide
White Lettering
Black Shading



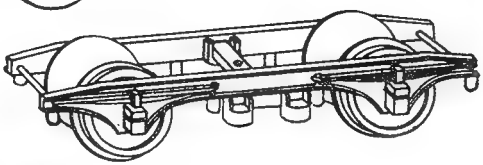
Black
Lettering Yellow

Fig. 30 PRIVATE OWNERS WAGON LETTERING
(English Wagons)

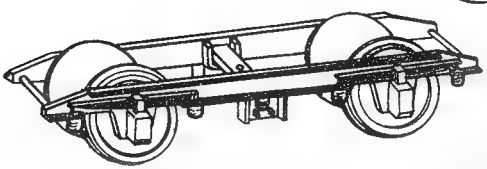
GEM COACH UNDERFRAME



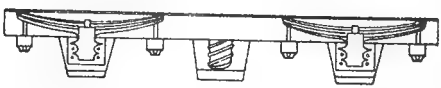
L.N.E.



G.W.



L.M.S. and S.R.



GEM Bogie Side

GEM COACH BOGIES

The New Gem "Equispring" Bogie

Built with sprung equalisation to ensure that all wheels remain firmly on the rails at all times, giving complete absence of derailments at points, etc.

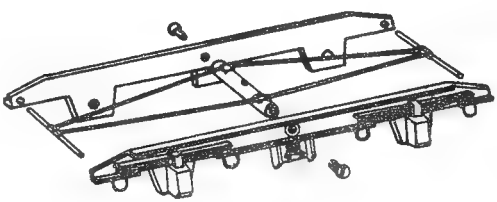


Fig. 31

It will be realised that in miniature this is impossible, for the load would foul on curves. The best arrangement therefore would be to pack slightly the load under ends which rest on the outer bolsters, so that the central bolster will clear. In C, we have a pair of lattice girders loaded on five wagons, three of which have no bolsters, the load being chained to the shackles of the two others. At the outer extremities of the girders there would be cross retaining members to hold the girders upright. Single wagons loaded with projecting planks have a maximum overhang allowance depending upon the carrying capacity of the vehicle and the material used in its construction. A match-truck is run under the projection. The same rule applies to tubes, and sometimes both tubes and planks are loaded so as to project at both ends, two match-trucks then being introduced. A sheeted load of hay or straw is shown in Fig. 43, as well as a load of pit-props, with the requisite ropings. In all instances where loads are roped, the ends are also tied down to the buffer sockets, and when tautened these ropes are bound with a loop across the ends of the vehicle.

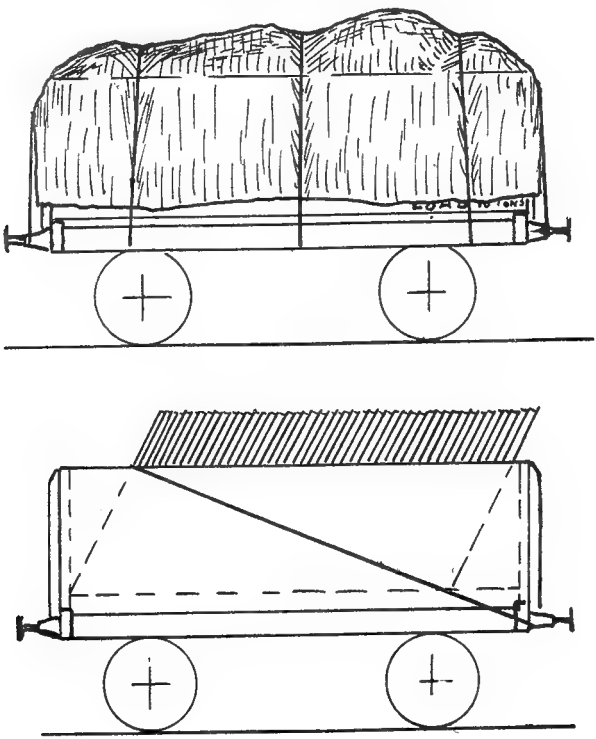


Fig. 43

COACHES

THE building of coach models, while it closely resembles wagon work, differs in one or two respects which render the task much more exacting, and indeed will cause the builder to doubt the wisdom of building his own coaching stock. For one thing, the cutting of windows in wood or card, not to speak of metal, is a task requiring the utmost care and patience; and secondly, the painting, lining and finishing even of the plainest stock demands a considerable amount of skill. To meet these conditions the lithograph-side system was originally introduced, and there is no doubt that excellent vehicles can be turned out on these lines. It is not generally known that the litho-sheets lend themselves to a variety of adaptation and

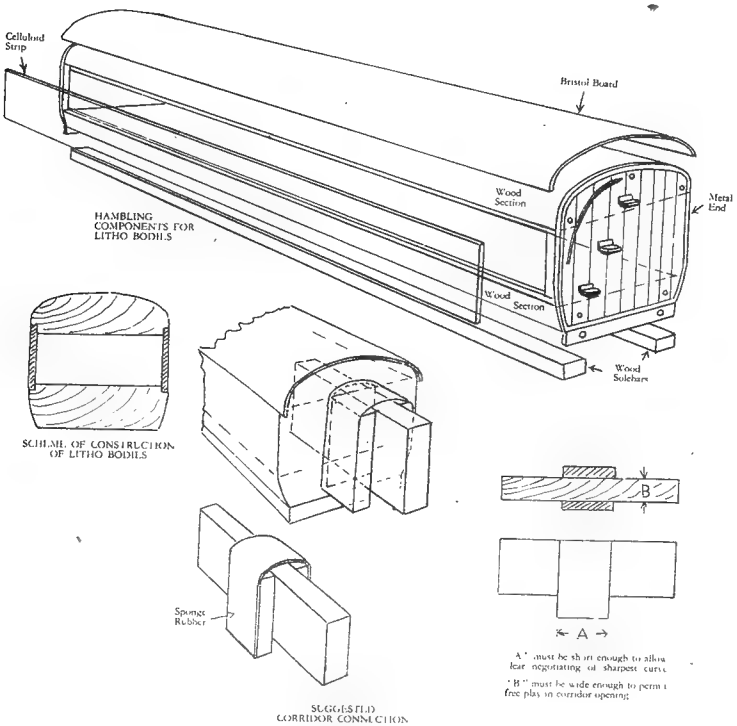
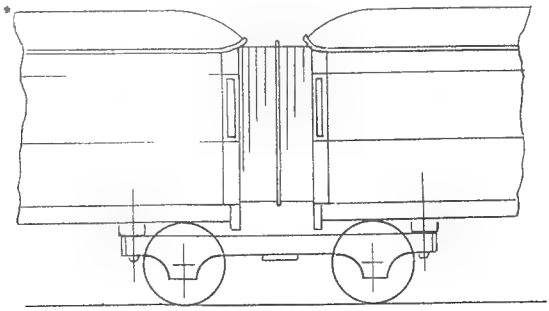


Fig. 32. LITHO COACHES

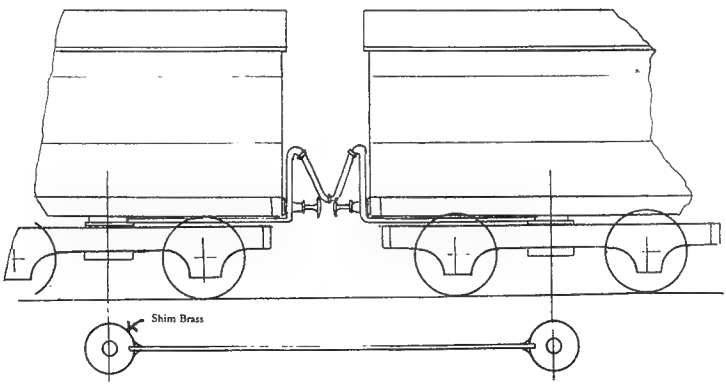
modification. A good six-wheel coach can be fashioned by shortening the papers, as indicated in the illustration on an earlier page. The advantage of the system mainly lies in the fact that full sets of components for the bodies can be had as standard.

LITHOGRAPHED COACHES

In Fig. 32 the details of litho construction are given. All the parts —floor, roof, metal ends and celluloid window strips cut exactly to size— can be had from Hamblings. They go together almost of their own accord as shown in the exploded sketch. The roof is a solid block, grooved for the windows ; the floor has a similar groove, and the metal ends, complete with " bow " and steps, have grooves for the ends of the window strip. The latter is a minute fit, and makes up a perfectly smooth side.

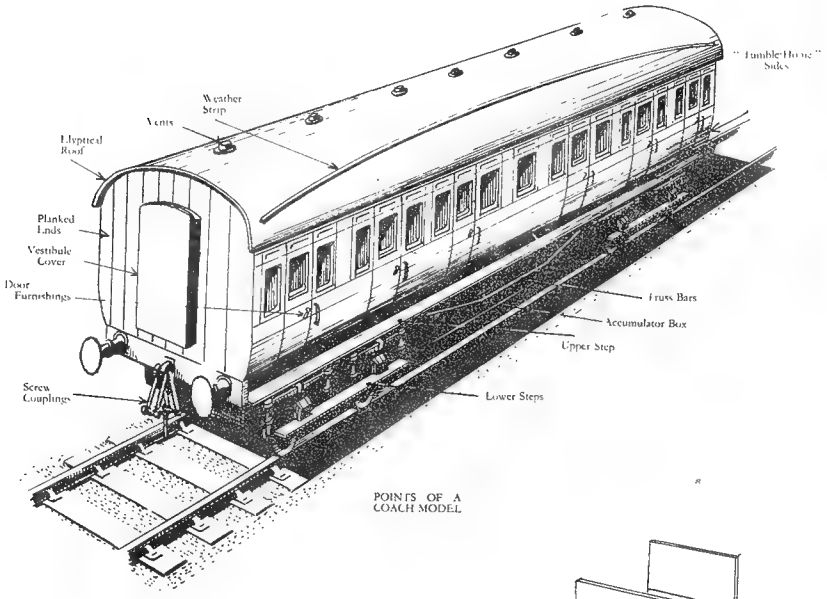


ARTICULATION

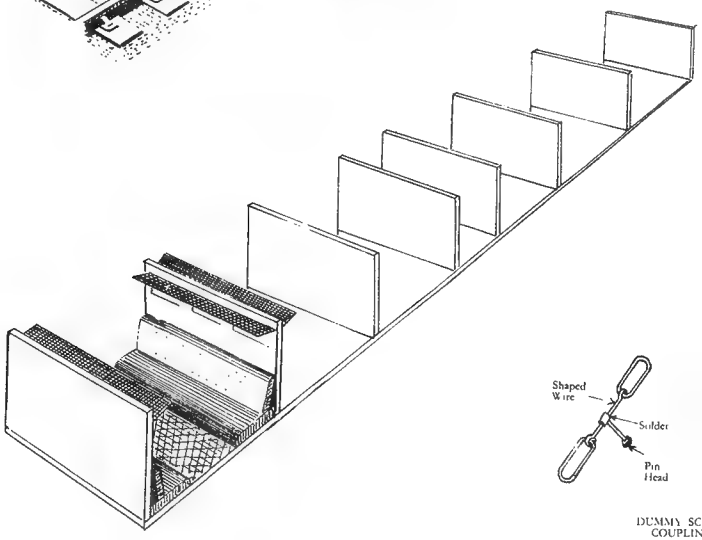


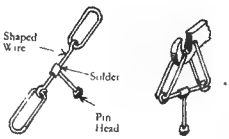
PERMANENT COUPLING

Fig. 32. LITHO COACHES

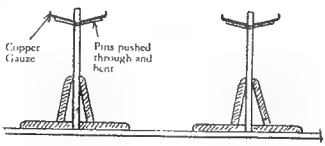


POINTS OF A COACH MODEL





DUMMY SCREW COUPLING



COACH INTERIORS

Fig. 33

Solebar strips are also to be had in stripwood, and these take the buffers. Some of the varied shaped ends are provided with corridor apertures, and a convenient form of simple dummy corridor connection is shown. Here, a small block of wood and a centre piece of sponge-rubber are employed. There is a wide range of correctly designed lithos to choose from for all the former groups, including L.N.E.R. all-steel coaches, Southern electrics, and all manner of suburban and main line stock. The provision of parts for under-frames and running gear is most liberal, and is the same, of course, for all types of construction, whether litho sides are employed or the bodies are handbuilt. In Fig. 31 we have a selection of Mellor coach bogies and a ready-built under-frame. Fig. 8 gives a large number of Hambling parts. Hamblings have sets of parts for all standard bogies, both four and six wheels. The fixing of the lithos is carried out much the same as with the wagons, the ends being finished first.

While dealing with coach bogies, mention must be made of one or two of the extremely refined types now offered in which equalising and springing of the wheels is introduced. The new Gem (Mellor) Equispring bogie is excellent, and so is the beautiful brass bogie by Bonds. The prices of these refined types are of course higher, but the running is so excellent as to make the outlay worth while. Buffers and couplings are also important items, and there are some special products here also. ERG spring buffers are a wonder, and the lovely square-socketed oval buffers by Bonds must be noted. Couplings are to be had as for wagon stock, of the standard three-link type. But for coaching stock I have always found it most desirable to have block-coupled trains, the outer ends of which only are provided with automatic couplers, and for this purpose the new H & N magnetic uncoupler is recommended. For the block coupling of a set of vehicles a scheme is given in Fig. 32 for a simple wire link which attaches by means of soldered washers—which must be very thin—to the bogie pins, and which is shaped to come up between the coaches to represent vacuum pipes. For the washers on these links the best material is shim brass, being of almost imperceptible thickness.

A word may here be said upon the subject of articulation. This system of coupling, which eliminates the need of half the number of bogies, and which was employed on all the earlier railway groups except the Southern Railway, has considerable merits. Hambling provides special bogies for articulation, which are drilled for pins at the ends instead of in the middle, and I would emphasise that this is the best method of articulation for models. If the bogies are pivoted at the centre the overhang at the

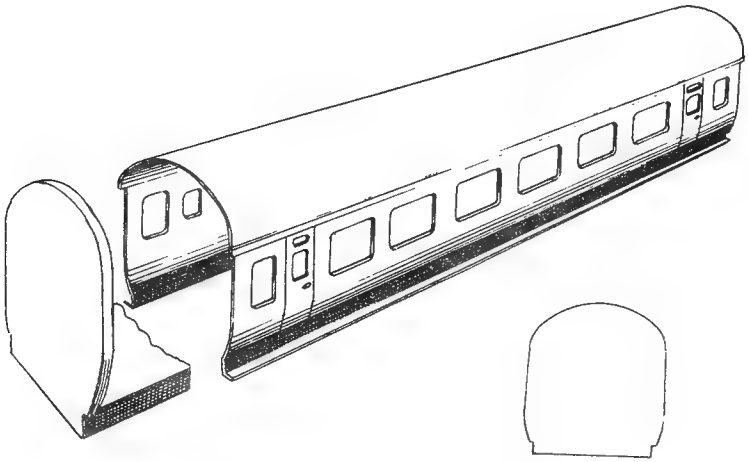


Fig. 34. "JAYPEE" COACHES

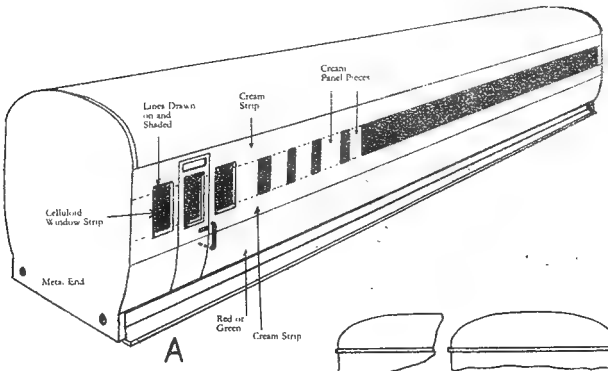
centre of the vehicles and the tendency to derail are alike greatly increased. With articulation, of course, the need of buffers is dispensed with excepting for the outer ends of a set.

HAND-BUILT COACHES

It used to be true to say that there was nothing to beat a hand-built coach ; but in these days I think I would be inclined to qualify that claim. A good piece of hand-work certainly takes some beating ; but in view of the splendid provision now made in 00-Gauge for kits of parts having completely painted and lettered body casings of metal, I am inclined to prefer the latter. But the hand-builder is still in evidence, and some of the work one has seen at the various shows is certainly magnificent.

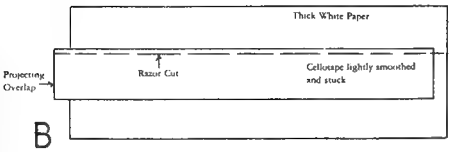
Fig. 33, then, shows some of the details which are to be borne in mind in building up a body from scratch. These include the shaping of the roof, the "tumble home" curved sides, planked ends, weather strip, steps, accumulator boxes, truss bars, door furnishings, vestibules and screw couplings. The latter are an added feature of interest where automatics are not to be used, and a simple method of making such a coupling is shown in the same figure. The fitting of suitable steps on the sides of bogies, where these are included in the original design, is a convincing addition. Material can be had for this special purpose.

Consulting Fig. 36, we shall find some guidance in the work of



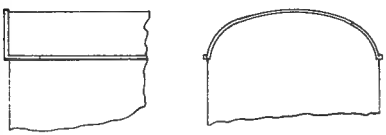
CELLOTAPE SIDES

PLAIN DOMED

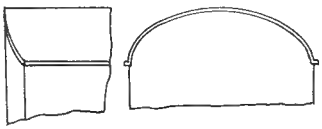


CUTTING CELLOTAPE STRIPS

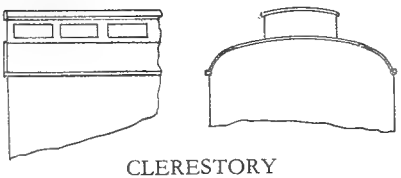
CURVED DOMED



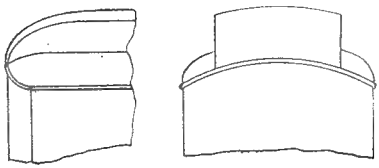
PLAIN



BOW END



CLERESTORY



AMERICAN

Fig. 35

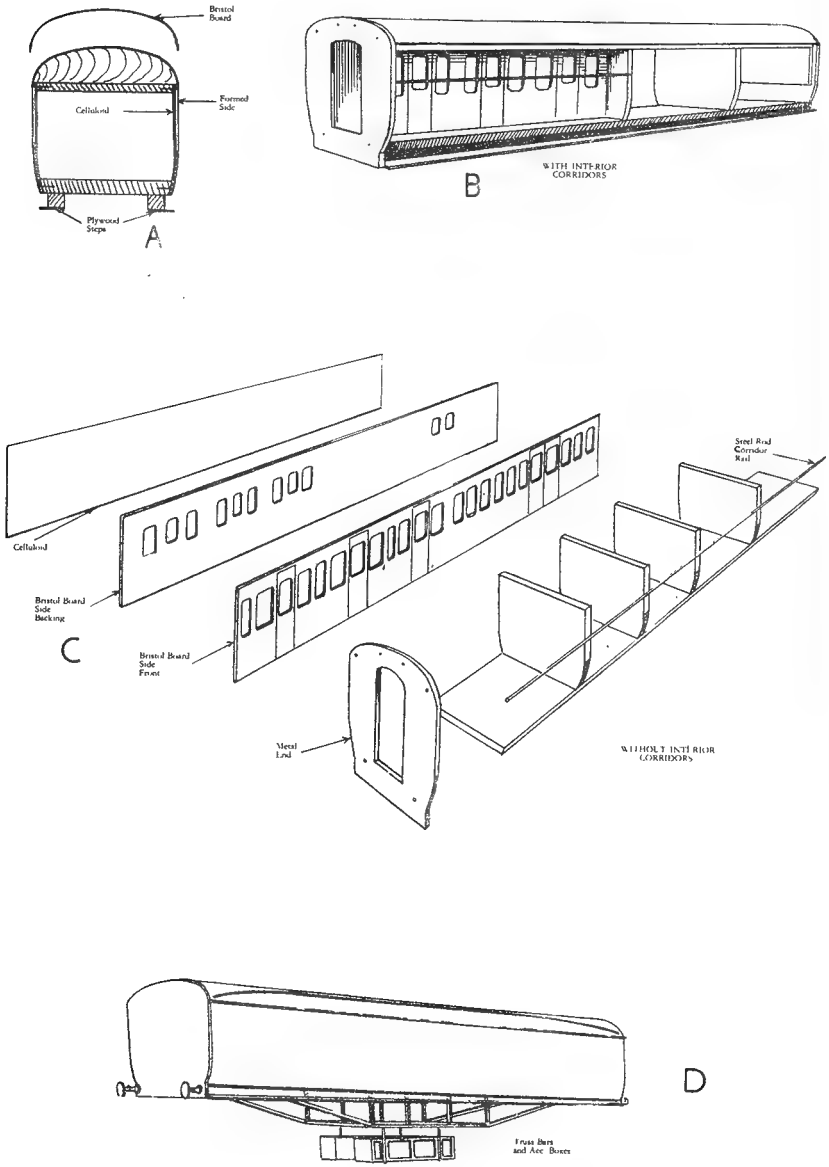

Bristol Board
Formed Side
Celluloid
Plywood Steps
A
B
WITH INTERIOR CORRIDORS
Celluloid
Bristol Board Side Backing
Bristol Board Side Front
C
Steel Rod Corridor Rail
Metal End
WITHOUT INTERIOR CORRIDORS
Truss Bars and Axle Boxes
D

Fig. 36

building. At A, we have the end section. This shows the general scheme. A roof piece exactly similar to the Hambling litho coach roof is used, or can be formed by hand; the floor is of stripwood, much thinner than with the litho floor. The sides are formed from two thicknesses of card, being two grades of Bristol board, the one (outside) being thinner than the other. The thick side piece has window apertures cut slightly smaller than those outside, and this has the effect of forming, when the two are stuck together, a double-sash, which is very effective at doors. The outer side, with its larger windows, can be cut first, then the inner side can be marked off from it with a pencil and cut accordingly. For rounded corners, use the shoemaker's punch.

The skeleton work on the inside is formed of partitions made of thin plywood as at C, and the metal ends must come inside and behind the ends of the sides. The partitions can be slotted to take an interior strip of gold-plated wire for the corridor rails where these occur. The longitudinal corridor partitions must also be cut for windows. The celluloid strip goes inside the side-walls. Truss bars (D) will be considerably improved by making them more detailed than is usual. A few added uprights, as in D, will secure this, and the longitudinals may even be increased to three. Accumulator boxes, dynamo, and such items are standard. The attaching of the sides until the glue sets can be vastly facilitated by the use of small elastic rings, looped over near the partitions.

The fitting up of coach interiors is not difficult work, and it adds much to the finished appearance. An idea or two may be gathered from Fig. 33. For the seats, ordinary planed stripwood may be used, if of a suitable thickness. Luggage racks can be formed from fine metal gauze tacked with solder to projecting pins. If lino or carpet is wanted for the floors, small pieces of paper print (replicas of carpet) may often be cut from catalogues or magazines, especially the American ones.

So far as the exterior finish of the vehicles is concerned, in earlier days I have seen excellent productions accomplished by the use of glossy adhesive tape. And strangely enough, only recently I came across a new material of this kind known as "Cellotape," which is sold in small reels at a reasonable price, which has possibilities. It can be had in pillar-box red, white, cream, green and other tints. In nature it is like Scotch tape formed from cellophane, and it requires no moistening. I made some experiments with it on the exterior of an omnibus with very outstanding success, and see no reason why it should not be used with equal effect on other vehicles. For this purpose I have given a few hints in Fig. 35. The drawing shows

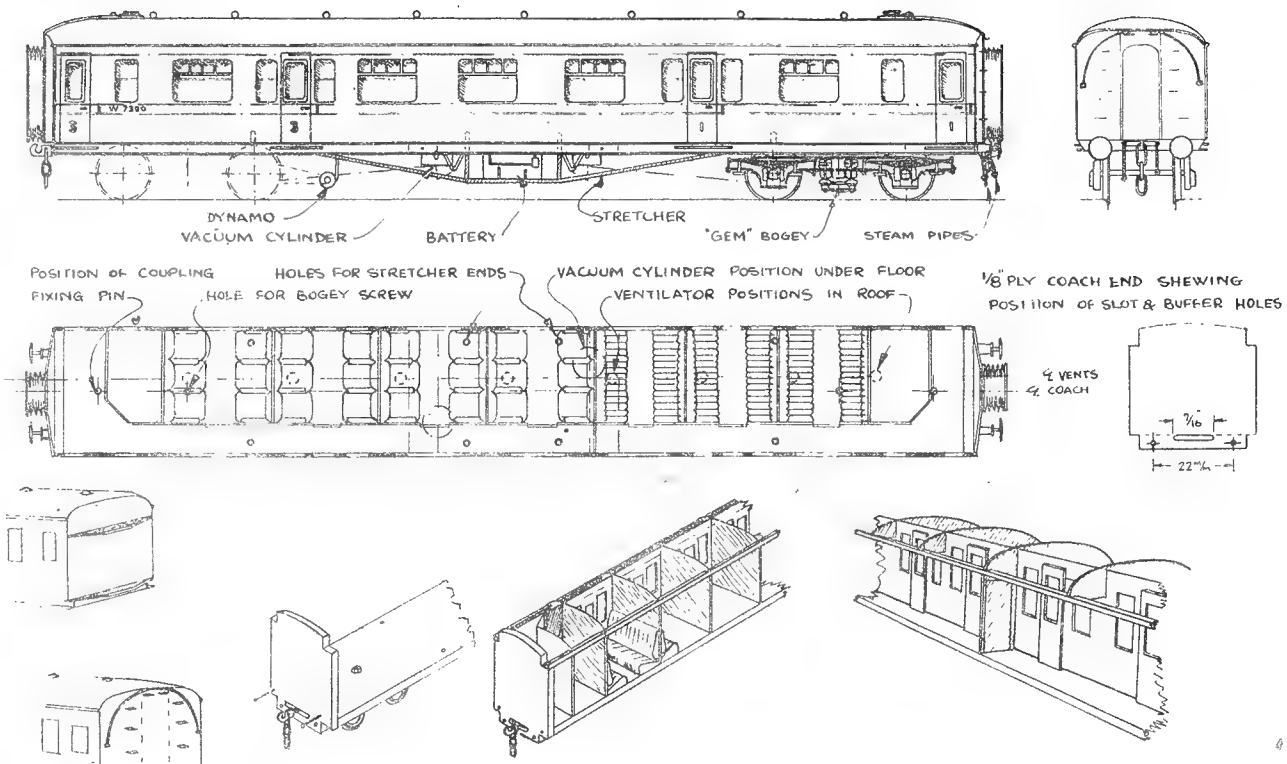
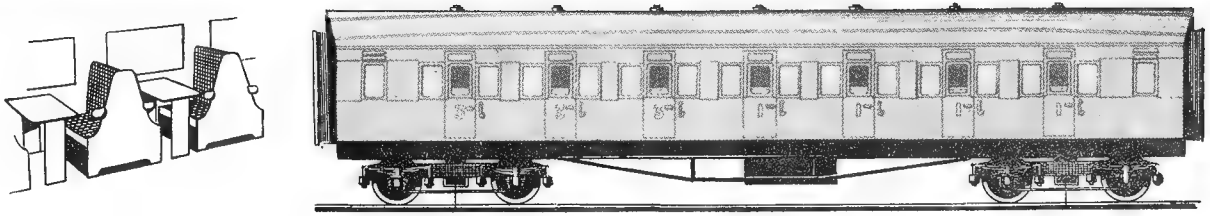


Fig. 37. SCALECRAFT COACHES



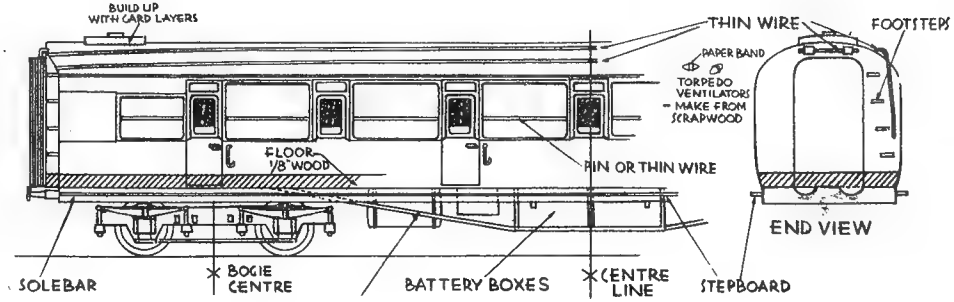


Fig. 38. MODELCRAFT COACHES

a coach before the roof capping is added. If the finish is to be cream and brown, let us say, begin with the cream strip along the upper side. Then add the brown strip below the waist. Then a second cream strip below the windows and above the brown. Do not lap the edges, but see that they are a perfectly straight cut and jump them accurately together. There is a knack in cutting the material straight. At B this is shown. Lightly stick the large strip on a piece of thick paper, make your cut, and gently peel off the cutting. In peeling off the strip, apply warmth. Leave the projecting overlap at one end to aid the removal of the thin strips. The sections between the windows are fitted last and must be carefully cut. Then the windows have a line drawn around them in black ink, the top and left-hand edge being hatched for the shading. Doors are similarly treated. If pin-holes are made in the sides before they are glued on, the door furnishings can be added in gold wire with a touch of glue.

There are all manner of coach roofs, a number of which are illustrated in this same figure. The domed roof ends are much more easily shaped, after a little practice, than would be supposed.

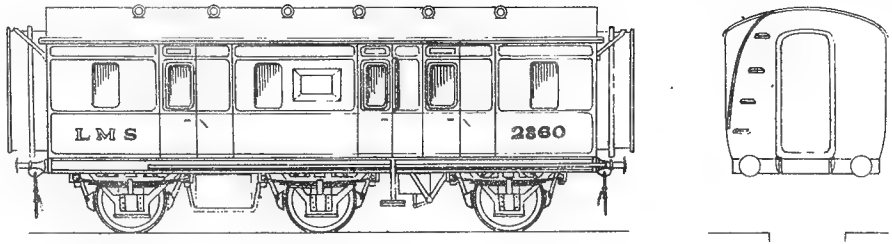
It may be mentioned in connection with hand-building, that the ERG series of wagon card-parts have their corresponding series for passenger coaches, and here again the drawing and scaling-down has all been done for the worker.

STANDARD DESIGNS

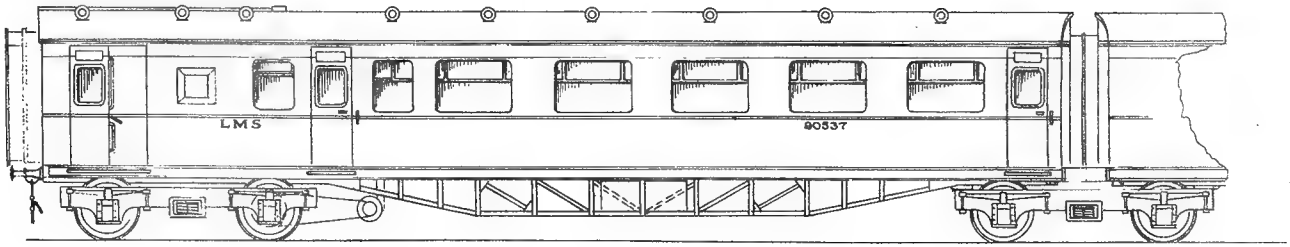
Not much can be accomplished in offering designs for prototypes, but the range of blue-prints obtainable is unlimited, and the worker should obtain one of these for each type he seeks to model. In Fig. 39 will be found designs for a modern six-wheel coach and an L.M.S. articulated unit for an excursion train. For freelance work, the use of American coach sides is not to be disparaged, for these are produced completely finished, coloured and lettered in gold. Fig. 42 gives an idea of how a Varney HO-Gauge side appears when applied to British body-work and running gear.

SENTINEL CAMMEL COACHES

For modelling these vehicles I would definitely commend litho papers which I have used in this connection for many years. They can be had in several letterings and numberings. I give a photo of one of these actual coaches, and in Fig. 41 I have worked up a design from the lithos in order that some idea of its completed style might be gathered. The body-work for this vehicle is executed entirely in glass and wood, the glass forming the sides with the simple addition of the lithos on the surface.



L.M.S.R. 6-WHEEL CORRIDOR PASSENGER BRAKE
(1933)



L.M.S.R. TWIN ARTICULATED BRAKE-THIRD COMPOSITE COACH

Fig. 39

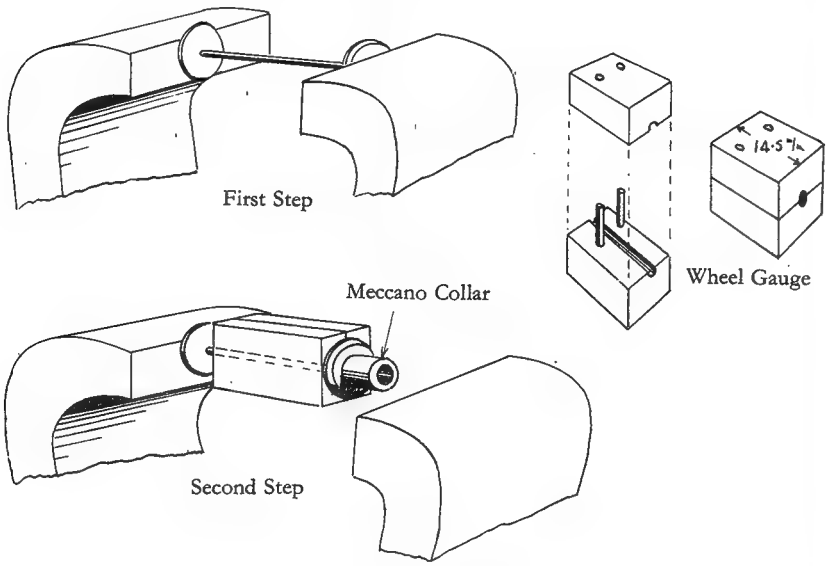
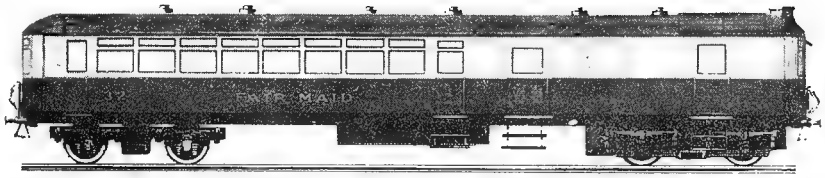


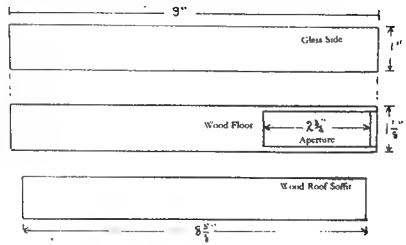
Fig. 40. FITTING AXLES

The diagrams will show exactly how the ends and roof are formed, and really the model presents the minimum of problems. Note that an aperture must be made in the floor to take the motor mechanism and that the inside of the ends, behind the celluloid, must be painted black or covered with black paper. The windows of the car happily have square corners and are therefore easily cut out. The roof is provided with a fillet underneath it, so that it is detachable at will. A further novel item is that of the duplex Cammel " Phenomena," which ran on the L.N.E.R. as an experimental train and would be a considerable feature for a model layout, offering more interest than a single-powered coach. This combination can be quite readily made up from two sets of the standard lithos suitably shortened and doctored in the manner shown by the illustration (Fig. 42).

COMMERCIAL COACHES AND KITS

There is still, in the opinion of the writer, nothing on the market to beat coach bodies by Edward Exley & Co. of Bradford, for either 00-Gauge or 0-Gauge. The dining car in 0-Gauge illustrated in a photograph is an early example of this builder's work, which has even greatly improved with the intervening years. At the present time, though his range is somewhat lessened, Mr. Exley is retailing coach bodies without running gear but ready for the fitting of bogies to the owner's taste. The





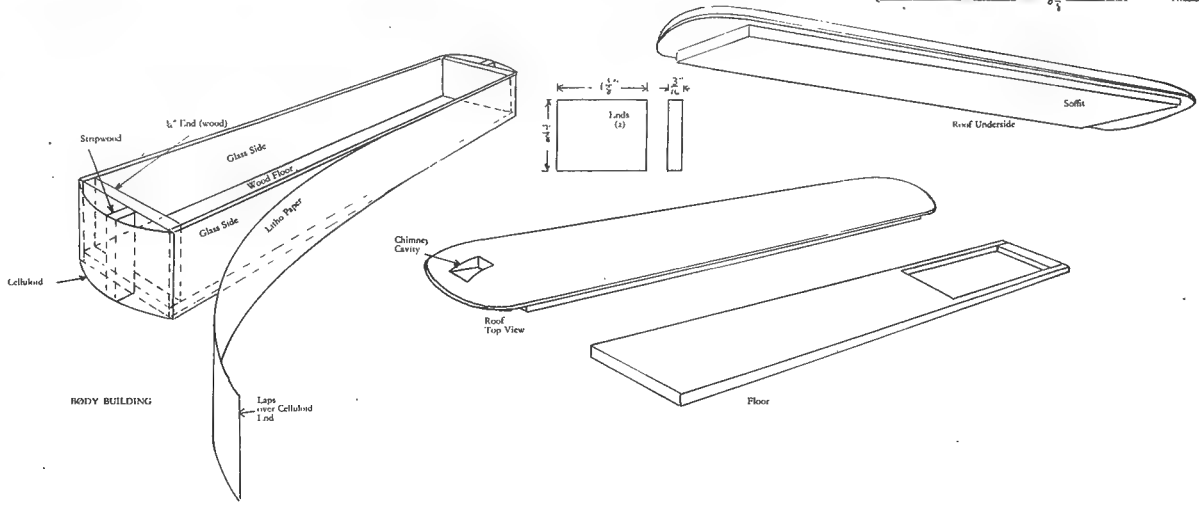


Fig. 41. SENTINEL-CAMMEL COACH

prices are very reasonable, and I believe that private lettering can be substituted on any former group stock with only a modicum of extra charge. For many years the West Midland Railway have ordered all their passenger stock from this source.

Certainly next in order I would place the new Jaypee coach kits, which offer completely painted and lettered roof and sides combined in one piece, formed from fine brass and beautifully worked and finished. The structure is of the simplest, and is yet robust (Fig. 34). Metal ends and all the details for under-frames are included in the kits and the prices are exceedingly low. L.N.E.R., Southern, G.W.R. and L.M.S. types can be had. All the work that is required seems to be the fitting of the ends to the floors, the adding of interiors, attaching the sides complete with windows by means of pins and adding the under-frame details.

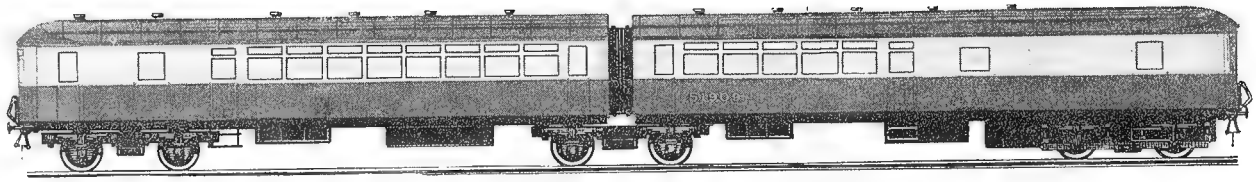
Another excellent 00-Gauge kit is put out by Scalecraft of Huddersfield. Similar in many ways to the Jaypee it differs in that the ends require to be built up from thin plywood provided and marked for the purpose. Interior details have materials provided, and the photograph will furnish some idea of the quality of the finished article. No bogies are provided with either of these kits. The drawing (Fig. 37) gives all the required information as to methods of assembly.

Excellent finished coaches are also on the market by Walkers and by Hamblings, and either firm are open to receive orders for owner's requirements. These models are, of course, produced by hand and bear no lithos.

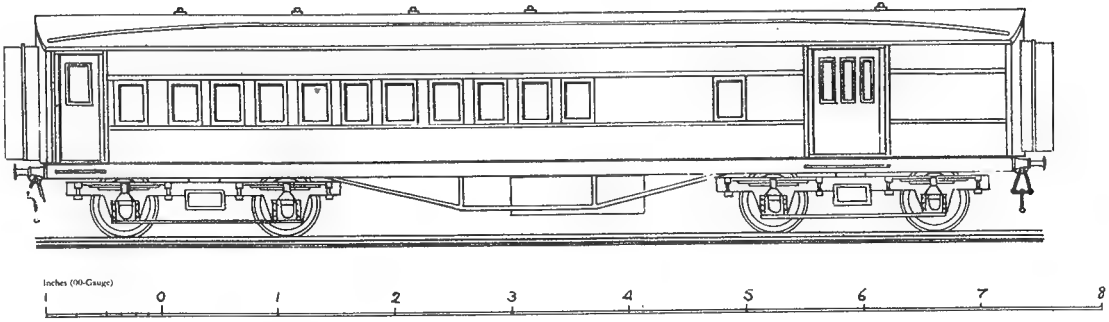
Modelcraft also publish a series of card parts for Southern Railway passenger vehicles of several types to this scale, these being illustrated in Fig. 38, which also gives a make-up depicting a finished unit. Card parts for the interiors are included, and all colouring and lettering is completed. If celluloid windows are added, these parts should make up very well indeed.

TWO-MILLIMETRE MODELLING

The newest candidate for public favour is the Two-millimetre Scale, numerous models under power having been exhibited at many of the recent shows. That the scale is a working proposition is demonstrated quite adequately by the fact that in America it has a large following and an excellent reputation. A firm known as Harold Products has produced a full series of heavily powered engines and cars having exact scale proportions, robust structure and perfect insulated running gear. I believe it is the intention of this firm to set up British agents very shortly, so that all



TWIN ARTICULATED SENTINEL-CAMMEL COACH
" PHENOMENON "



FREELANCE COACH (British Form) with Varney
60 ft. HO Sides

Fig. 42

these components will be obtainable here. In Figs. 44 and 45 will be found a series of full-size diagrams introducing some of the possibilities of this scale for British builders. Two of the standard locomotive models are shown as sold. The motor used is a Pittman type which is generally employed on American HO-Gauge models, and should have enough power to pull anything in half that scale. Both passenger and freight trucks can be had, so that any of the proposed British designs would be perfectly simple to make up. A little difficulty might be met with over the goods axleguards, but this with care could be easily overcome.

NARROW-GAUGE STOCK

The same components have also possibilities in relation to British narrow-gauge models to the 4-mm. scale. Fig. 46 will show what I mean. Here we have first a locomotive and open wagon of the narrow-gauge type. In order to secure reduced dimensions, metal side-frame of the $3\frac{1}{2}$-mm. scale are adopted. A narrow-gauge coach is built with H-P passenger bogies, and thirdly, we have an engine built from a Reidpath 00-Gauge cast body on the American express locomotive driving wheels. The cast body will require slight reduction in width (by filing) over the foot-plates. The track for the American kits is about $\frac{1}{2}$-in. Gauge and all manner of two-rail formations can be had.

Several other firms in America are given over to the production of these models, and where 2-mm. scale is the vogue, several excellent freelance wagons now on sale by firms like Jewel Models can be worked in.

PAINTING AND FINISHING

Much of what has been written concerning wagon stock will, of course, apply to the painting and lettering of coaches, though the latter work is certainly more exacting than the former. The important factors are the cleanliness of the model to be painted, the quality of the paint, the type of tools to be used, the measure of practice involved in good lettering and the ultimate varnishing of the work.

Camel-hair brushes of the artists' type are best for small-scale models. These tools should be of the best quality in order that they will not shed loose hairs on the work. A new brush should be soaked in cold water overnight. There is a technique for actually executing the paint work, the idea being to cover a little space at one time, and to work along a planned route which will not involve any "coming back" when the coating is half dry. When two coats are required, be sure that the first is thoroughly hard before giving the second. Before starting operations the

model must be cleaned of all grease-marks and dirt. This can be done in several ways, depending on the material used on the model. But the best way, where imitation glass windows are involved, is to rub the work with cotton-wool soaked in turpentine or other paint thinner. What has been said against using old paint may be repeated here. Almost everything in fact depends upon the kind of paint used. The colour of a coach must be exactly what it is supposed to be, and one piece of work will require to match up exactly with its predecessors in shade and texture. So buy paints in small containers from the firms who sell the right thing. Personally, I never use cellulose colours ; but that may be merely a fad of my own, for some of the best paints, strangely enough, have a certain admixture of the cellulose elements, and are certainly not thorough-going oil paints. Experiment is the best guide. If paint should be lumpy, suspect it of being too old, though sometimes it can be put through a strainer. Any lumps whatever are fatal to the work. Be careful that the paint is thoroughly stirred and shaken before use, otherwise there will be too much oil in it, causing it to dry glossy where it is required flat. With regard to flatness and glossiness of finish, again, the demand will vary with the work. With wagons, for instance, most private owners' vehicles are given a varnish coat of the glossy kind, while company wagons never are. With coaches, while the finished job will require to be glossy or semi-glossy, this may be achieved either by using one coat of glossy paint or by varnishing a flat paint.

For lettering coaches water colours are again recommended, together with the common mapping pen ; but here once more the preference may be only personal. The pen is used as with wagon lettering, along with a stand magnifier. Perpendicular strokes are freehand, horizontals ruled, always working from the top downwards or from left to right. The position of the arm and wrist is of immense importance in lettering. The wrist should rest at the same level as the surface being lettered. For this purpose I use any ordinary book from my shelves, with the vehicle body set close up to the edge of it. The grip on the pen should not be rigid, but relaxed. Know exactly what size and form of letters you are going to make, and precisely where they require to be placed. For this purpose I myself never make any marks on the actual model, but work rather by pre-calculation of letter-spaces. Or, if necessary, the legend may be written out in full, with pencil, on the top edge of a piece of cartridge paper, which can be held close up to the model and copied. This method is excellent when it is desired to letter numerous legends of identical form. Study the

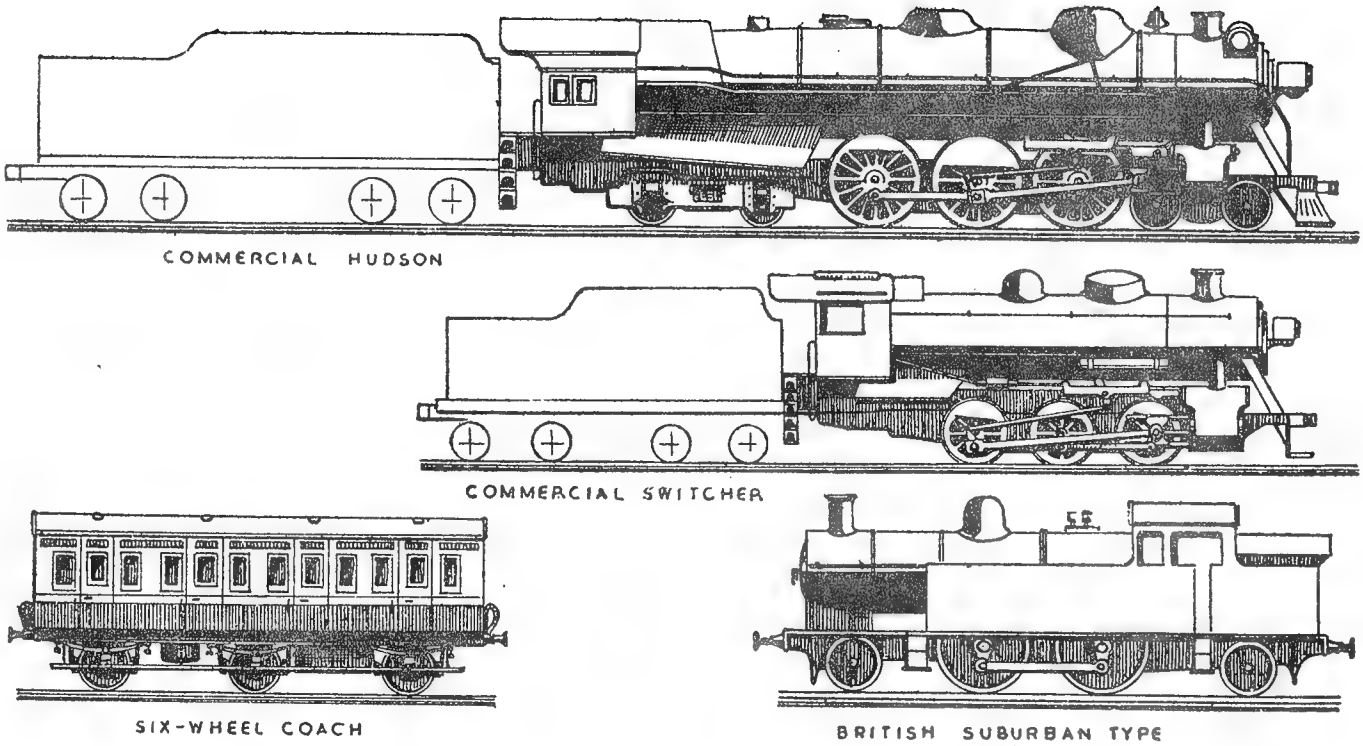
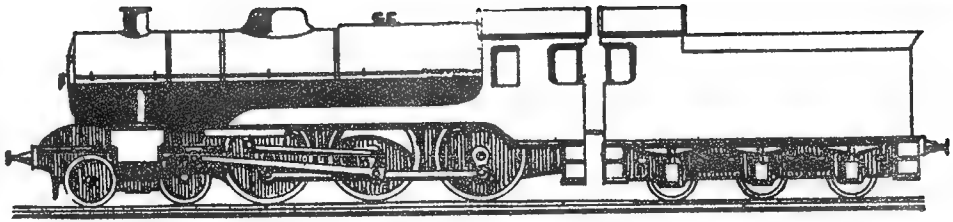
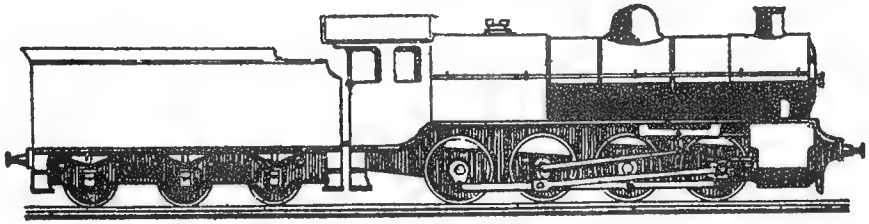


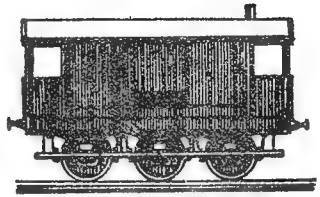
Fig. 44. TWO-MILLIMETRE STOCK



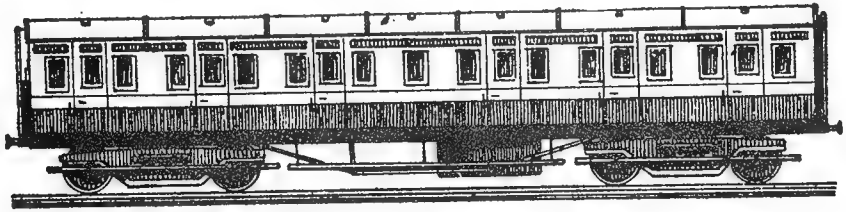
BRITISH PASSENGER TYPE



BRITISH GOODS LOCO



BRITISH GOODS STOCK



BRITISH BOGIE COACH TYPE

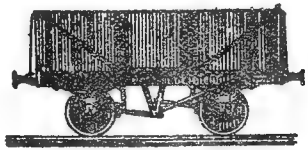
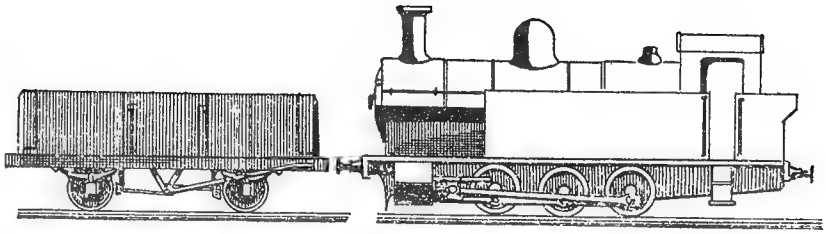
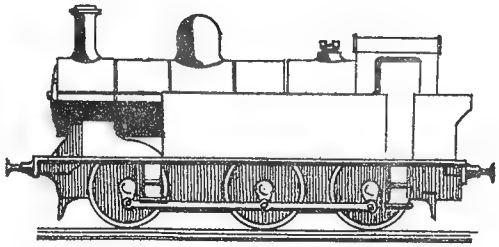
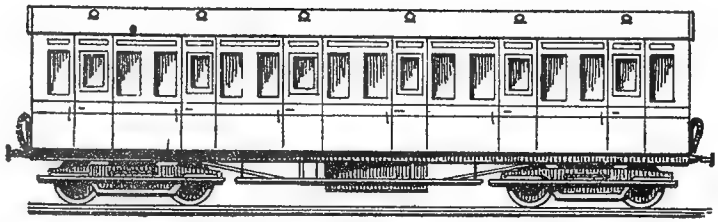


Fig. 45. TWO-MILLIMETRE STOCK



Narrow-gauge wagon and locomotive





Narrow-gauge coach

Fig. 46. NARROW-GAUGE STOCK

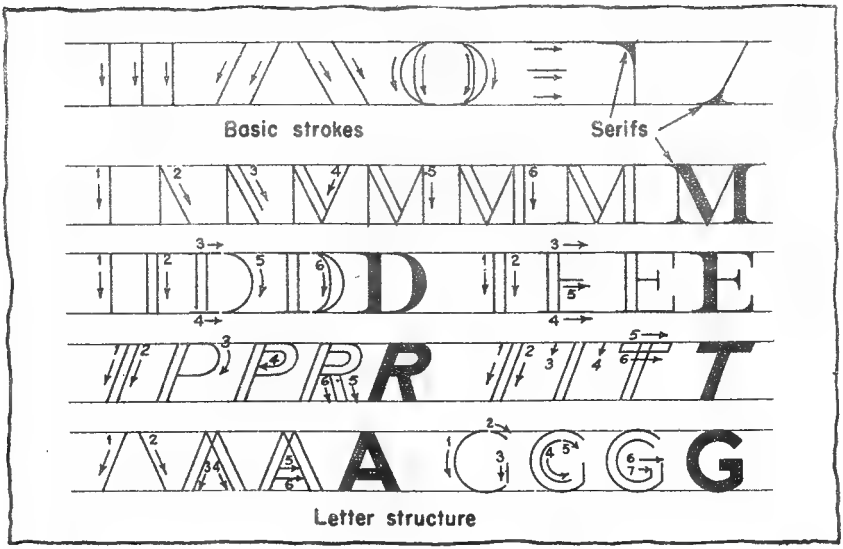
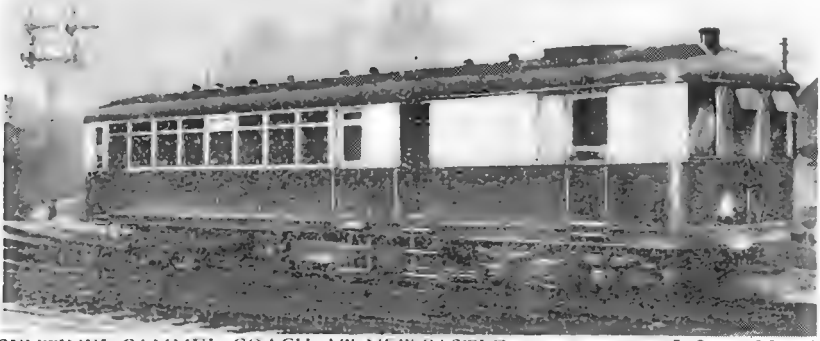


Fig. 47

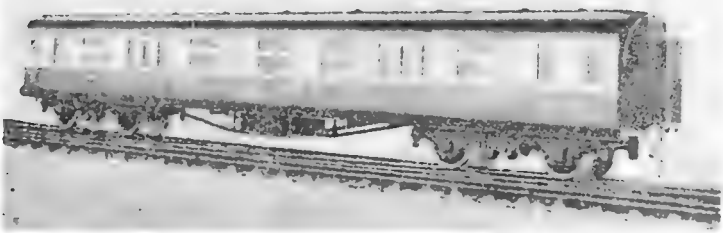
type of lettering used. Roman lettering has thin and thick strokes with serifs; Gothic lettering is plain, though each type has its modifications and developments. The diagram in Fig. 47 shows (with acknowledgments to the *Model Railroader*) the two principal forms and also how letters are built up.

Lining is accomplished also with a pen and ruler, the ruler having a bevelled edge which cannot foul the line. The majority of modern coaches have their lining reduced to a bare minimum, though on earlier models there may be quite elaborate panelling. If a glossy paint has been used for the body-work, it will often be found that the water-coloured lining will not tend to rub off; but on a flat surface it will. It is therefore necessary to coat the whole surface of the model evenly with Fixative or with very thin copal varnish.

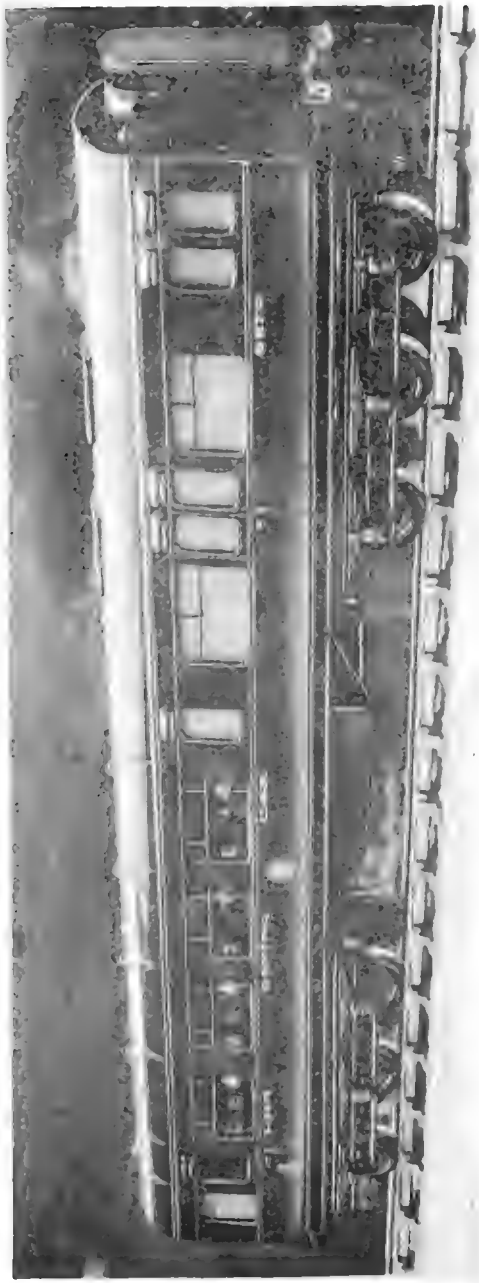


SENTINEL-CAMMEL COACH AT NEWCASTLE (*J. Stuart Morris*)

DUPLEX SENTINEL-CAMMEL COACH "PHENOMENA"

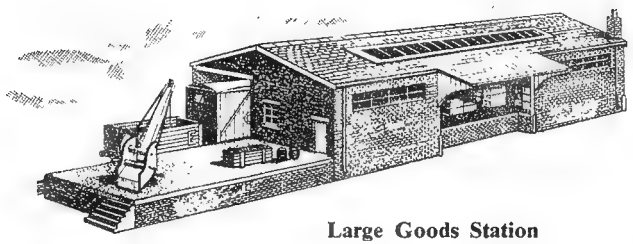


"RAILCRAFT" G.W. TYPE COACH (oo-Gauge)



16-GAUGE DINING CAR BY EDWARD BEXLEY

Lineside Kits



Large Goods Station

The " Lineside " range of kits has been introduced to meet the demand for an inexpensive, easy-to-build kit of parts for railside buildings and features in 4mm. scale.

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Country Station ...	... 5/6	Water Towers	... 2/9
Large Signal Cabin	... 4/7	Footbridge	... 2/9
Small Signal Cabin	... 3/8		

Prices include Purchase Tax.

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The author proceeds in the second handbook to get down to the actual work of designing, planning and building a layout, starting with the standard dimensions and Ministry of Transport rules. Such items as the formation of the superstructure, the provision of necessary facilities for goods, passenger and locomotive traffic and servicing are all presented from the standpoint of the writer's lengthy experience, as well as that of other well-known designers. *Price* 4/6d., *by post* 4/8d.

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While it is true that Two-Rail control has deservedly captured the imagination of the railway modeller, it is also a fact that there are thousands of workers who prefer the Three-Rail system. Mr. Beal has not forgotten these people, and has furnished in this handbook all the guidance they require regarding the selection of the best switches and controllers, the wiring of points and crossings, track sectionalisation and the wiring up of a complete layout. *Price* 4/6d., *by post* 4/8d.

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Book 6. Wagons and Coaches.

A page of diagram is worth a chapter of talk, and the man who wishes to practise this most intricate branch of the craft will find that, as he works, he will almost certainly have this book open at a page of beautifully clear drawings. Mr. Beal's impartial survey of the market of commercial parts and complete units is most useful. *Price* 4/6d., *by post* 4/8d.

Book 7. Two-Rail Control.

The advantages of Two-Rail control as compared with the older Three-Rail system are fully explained and the author shows lucidly how much simpler it is to install and operate. Various methods of amateur track constructions are described and there is a complete chapter dealing with the commercial types of track available. The subject has been covered comprehensively and there are numerous illustrations.

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Book 8. Miniature Traffic Working.

In this book the author describes how the rules of real railway procedure can be simulated in the operation of a miniature layout. Reading through the opening chapters, the owner of a newly-completed layout will soon realise that his work is far from finished. Such points as operating procedure, scale speeds, time-table working and so forth have all to be studied, and these, and many other interesting features are dealt with fully in the eight comprehensive chapters.

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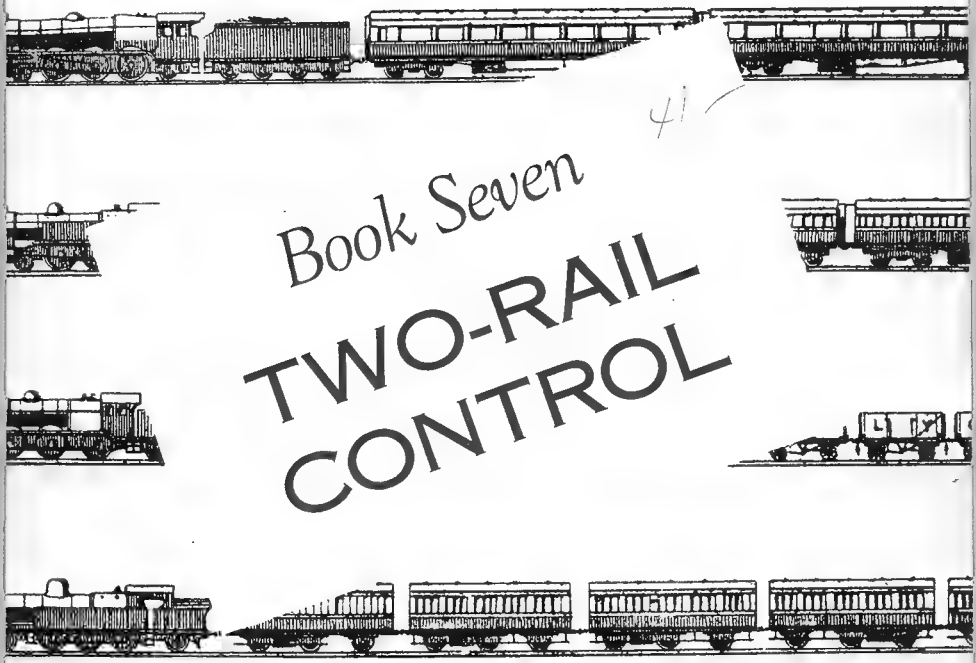
Edward Beal's

RAILWAY MODELLING SERIES



Book Seven

TWO-RAIL CONTROL

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Published by

Modelcraft LTD.

77, GROSVENOR RD., LONDON S.W.1.

Edward Beal's Railway Modelling Series

BOOK SEVEN

TWO-RAIL CONTROL

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TWO-RAIL CONTROL

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TWO-RAIL CONTROL

DEVELOPMENT OF THE IDEA

THE Two-Rail System of miniature railway operation and empowering is that system whereby, instead of being fed through an insulated third rail, the driving current is supplied through one of the two running rails and returns through the other. No extra third rail is therefore required. And since there is no isolated conductor-rail, there is no need of any visible collecting shoe to run along it; the positive element of current passes through the wheels on one side of the locomotive and the negative through the wheels on the other side.

When the earliest working railway models having electric propulsion were first placed on the commercial market the three-rail system was widely adopted, mainly, in all likelihood, because it promised to be cheaper and simpler to produce. In later days, when scale-model permanent way came into use, the third-rail idea was continued almost as a foregone conclusion. It was not until scale modelling began to be a more advanced and perfected craft that enthusiasts began to experiment with the two-rail method.

Notable among those who some twenty years ago began work which was more or less pioneering were Mr. A. R. Walkley, who combined his efforts with a miniature gauge, then unheard of, of $\frac{5}{8}$ in., and Sir Eric Hutchison, Bart., who worked in o-Gauge. At about the same time, several commercial houses in America brought out two-rail schemes as applied to their " toy " railway outfits; and by very slow degrees the system has caught the imagination of scale workers all over the world, until in America, where there are some 100,000 devotees, little else but two-rail is to be found among the smaller standards. In Britain, since the last war, the idea has caught on to an altogether remarkable extent, so that all the commercial tracks and components are now put on the market to suit this system, while at the same time being capable of application, if desired, to the old third-rail idea.

PREJUDICE AND SUSPICION

Like every new departure, when an older procedure requires to be replaced, the innovation of two-rail has not been wholly welcome. In the first place, many of those commercial houses who had invested considerable finance in three-rail, were not immediately willing to scrap their costly plant and espouse a new line that had barely established itself. It was not entirely surprising that some of these firms found a useful implement in the widespread misapprehension that the new system was extremely intricate and unreliable in its operation. Even for this misapprehension there was ample excuse, for undoubtedly some of the early diagrams, describing a method of which even its advocates were a little frightened, were complicated in the extreme. The delineation of wiring schemes was hampered by the notion that the snags were infinitely greater than they really were, and much of the diagrammatic work was painfully directed against providing for these imaginary difficulties. It was, for example, felt for years that point-blades could not be relied upon to direct current, and that a multiplicity of switches were required to do the work which the point-blades can do themselves most naturally. Half a dozen other switches would be provided to do what can be done, it has now been ascertained, by a mere gap in a rail or a single strand of bonding wire. Altogether, I think it may be said, two-rail is far simpler than three-rail both to instal and to operate.

The fact is that the actual underlying requirements of both systems are exactly the same—correctly laid track, successful current-collecting and careful wiring. The only special demand of two-rail is the insulation of all wheels, and now that the commercial houses have seriously taken up the idea, these wheels can be had as easily as those formerly sold for three-rail. And against this little extra outlay of thought and care we may place the fact that the remainder of two-rail equipment is far cheaper and less extensive than could be said of its earlier and interloping competitor. An evidence of the truth of this statement may be had by consulting Fig. 1 (A and B), where I have given a diagram of a two-rail point along with one of its three-rail brother. The contrast needs little comment! For two-rail, well, the point is simply a point, while for three-rail it is a conglomeration of useless metal-work.

ADVANTAGES OF TWO-RAIL

I think the most outstanding advantage of two-rail is simply its suitability and relevance to the situation. That is to say, the system so amazingly and almost at times uncannily fits into the framework of point and track formations. Thus, in attacking the problem of wiring up a scissors crossing by the two-rail method, one is instantly astounded by the manner in which the meshwork of the trackage lends itself to feeding one element of the current from one side and the second element from the other. There is, of course, no ordained reason why one of the rails should do the work in perfect accordance with the other; but this is simply what happens, so that it almost appears as if the actual feeding of current in this manner were something that the early engineering fraternity had inadvertently left out. For this reason alone, I think, no one can experiment with the idea without becoming a bigoted convert to its magic.

But when we come down to practical considerations we find the real advantages. There is first the matter of appearance itself. It was really most clumsy and ridiculous to wed the all-electric third-rail system to steam-outlined locomotives, for these units never can and never will use that system unless in concert with all-electric motive power. And how one realises now, on looking over old pictures of third-rail layouts, how ugly that third rail was! How it spoilt the lovely network of running tracks! And those ungainly collecting shoes, projecting from beneath the footplates and frames of the finest engines! Who would not be only too glad to dispense forever with them?

Two-rail gives better contact for current collecting than does three-rail. If needs be, all the wheels of both locomotive and tender can be made to form perfect contact and a medium for the passing of current at the same time; and if, as will happen sometimes, certain of these wheels are out of contact when passing over point gaps, there are always a sufficient number unfailingly carrying on the work.

For two-rail, again, much less outlay in time, labour over construction, and in wiring is involved, not to mention that of cost. The track is more quickly built, after the initial practice that also required to be expended on the earlier method, and there is far less labour in it. The amount of wiring is reduced by more than half, and that is a serious item.

But I would advocate two-rail myself, if only on the grounds of convenience for track-cleaning. On a layout of considerable dimensions, it was a tremendous and tedious task to keep the track-surface and conductor rail clean, for the simple reason that even a carefully shaped sanding block would inevitably break down the conductor rail while in

use, being especially addicted to the lifting of the rail ends. To get satisfaction from a hand vacuum-cleaner was impossible, for the nozzle would never approach the baseboard closely enough to draw out the dust. But with two-rail all is different. The block slides smoothly over the track-surface, the vacuum nozzle sets firmly down upon it and the baseboard feels the suction. There is nothing to knock against, nothing to put out of commission.

And futhermore, of course, there is the invaluable asset of automatic track control which becomes possible with two-rail and was never known before. In fine, the blades of the points may be (and should be) arranged so as to divert the power-supply into the road which is being opened by their movement, as well as to exclude the supply of current to those tracks which are being closed to traffic. This task the point blades will do quite willingly and remarkably with ordinary care and thought in planning. Not only so, but the employment of this expedient will, in nine instances out of ten, completely eliminate the need of tie-rod switches and section plugs on the switchboard. This is an invaluable feature.

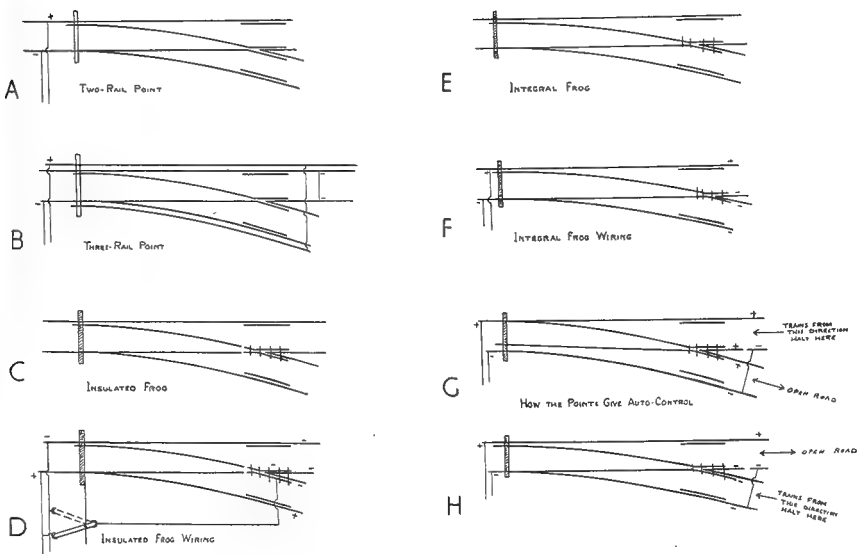


FIG. 1

THE VARIOUS TYPES OF SUPPLY

It is not generally realised that there is not merely one, but that there are many systems within the system. The earlier idea was that of the insulated frog (Fig. 1 (C)). Here, at a turnout, the entire frog was cut off by gaps from the blade end of the mechanism, though bonded as one piece in itself. When the point was supplied with current, the frog, with the tracks beyond it, was left dead. Because it was thus dead, it was necessary to feed it separately with current according to the lie of the point-blades and the requirements of the open road. For this purpose, it was usual to fit a small sliding switch on the point rod, which, when the point was operated, fed the current as negative or positive according to the polarity of the inner running-rail to be used. Every point, therefore, required one of these tie-rod switches to render it efficient, and that in itself was a great work.

It may be taken, I think, that the insulated frog system is now entirely superseded, unless at occasional locations where the conditions demand such special isolation. The point having an integral frog, or a frog in one piece and one circuit with the rest of the point, is now the style in general use. It is illustrated in Fig. 1 at E, its appropriate wiring being shown at F. It will be realised that when the frog was cut away by gaps from the rest of the structure the entire strength of the unit was jeopardised, whereas the integral frog makes a thoroughly robust and unified structure, while of course avoiding many complications.

Passing on to G and H, we see how the movement of the point-blades gives automatic distribution and exclusion of current. In G, the road is set for the branch (either direction) and the trains approaching from the rear end on the straight road will not move when they stand at a place where the rails present two positives instead of a positive and a negative. Similarly, in G, the road is set for the straight and trains from the branch line will (as they must for safety) stand, for they will be provided with a couple of negatives. This, it may be stated, is the whole system of two-rail in a nutshell.

Besides these two methods—the insulated and the integral frog—there are and have been others. It is proposed, however, not to deal with them in this handbook in order that complications and needless words may be avoided. The integral frog method decidedly lends itself in a remarkable manner to the simplification of the whole system, and when intricate formations are required it may be said to wipe out instantly half the possible difficulties and labour. It ought, however, to be said that none of the schemes so far evolved, and none in this handbook, have any claim to be restrictive. There is unlimited scope before the investigator who cares to devote time and study to the subject.

A further question of supply is that of whether the battery service for empowering the rails shall be in a simple series wiring or on the principle of the split-potential. It is really a question of the personal preference of the owner, both forms being alike serviceable and satisfactory. If there is an advantage in favour of the latter method, it lies in the life-period capacity of the batteries, since the alternative use of the one set for the forward movement and the other for the reverse possibly tends to allow for quicker and fuller recuperation. The use of two sets of batteries of 12-volts capacity each set does also allow for the possibility of wiring across both sets for purposes wherein a higher power is needed. I personally have adopted this method for many years in preference to the other. But in Fig. 2, at A and B, I have given the method of wiring for both.

There may be occasions, also, if commercial points are purchased ready made, when it will be necessary to convert a turnout having an insulated frog into one of the integral-frog type. This can easily be accomplished by simply linking the rail up at the gaps by means of fishplates, as indicated at C. In order to guarantee perfect conductivity, it might be as well to add a touch of solder to the plates. When sleepers are given the scale spacing in such a small scale as 00-Gauge, I never rely upon the conductivity of a mere fishplate, since these must then of necessity be extremely short. The best method of bonding up the various lengths of track is shown at E, where, after the fishplate has been set in place, a short length of wire is soldered across the two extreme chairs. This should, of course, be done on both rails if they are to be continuous conductors. Sometimes, however, it is desired to link up for smooth running the two ends of a rail where insulation gaps occur, and the soundest way to do this, I think, is by using a common fishplate (the longer the better) into which a piece of drawing paper has previously been inserted. The paper will adequately serve to stop the flow of current, while the fishplate will retain the tracks in true alignment. But if paper is not to be trusted, then some very thin fibre may be used instead.

It has hitherto been one of the common maxims of two-rail wiring that the current must always be fed into the point-blade end, or the open end, of a turnout, or of any other point. Let it be said that this rule, while a desirable one to keep in mind for general practice, is not by any means a binding one. Even those who have advocated it have been compelled to allow for certain exceptions. In Fig. 2 at F, G, H and I, there are four methods illustrated, only one of which, the fourth, is incorrect. In F, the orthodox method is given, with the addition of the almost inevitable jumper-wire which passes the current from the mouth of the point to the gapped running rail behind the turnout, on the same side as the turnout. In G, the entire rule is deliberately broken with no evil results whatever except that the course of the current behind the point must be watched. In H, the positive is led into two of the rails behind the point and into the third running rail in the same location separately. The adoption of either of the three methods depends purely

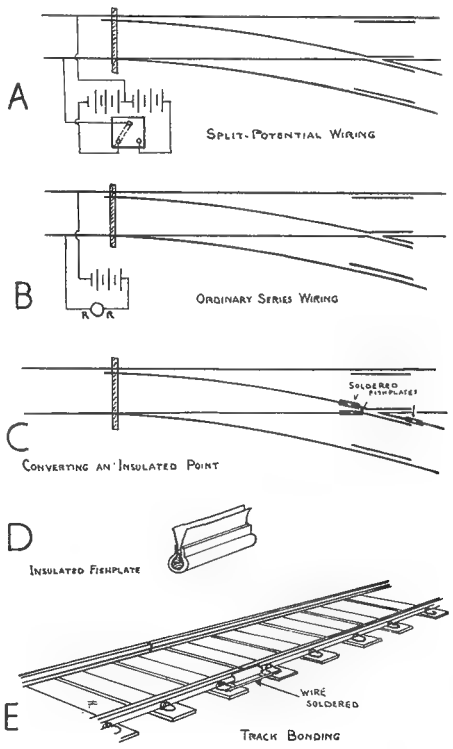


FIG. 2

METHODS OF FEEDING CURRENT

upon the track situation, though the first is the simplest and usually the least confusing. In I, the method is wrong, in that a dead short will occur behind the frog.

There is yet another question regarding the type of control to be adopted, and that is whether, in the instance of having both " up " and " down " roads on a layout, these shall be under a single controller or shall have each a controller of its own. Thus, in the two upper diagrams of Fig. 3 (A and C), we have a crossover correctly wired and in which both tracks are under a common controller. This means, of course, that only one train can be run at a time, since, when the " up " track is switched in the " down " track will also be under power, at the same polarity as the " up " track. This means that a train on each track will only be able to run in the same direction as its companion train. It may seem that this is a poor method of operation; but the matter is not quite so readily dismissed as that. To begin with, it is not in the number of simultaneously running trains that the fascination of operating lies, though many novices think it is. Where a large layout is worked by one person, one train is usually enough to manage at once. And, secondly, the whole matter of wiring up for two-rail is infinitely simplified if only one controller is used.

Having made these statements, I hasten, of course, to add that a single controller would never give me satisfaction myself. For a multitude of other reasons I would adopt dual control. Nor am I at all of the opinion that dual control is in any degree complicated. It simply happens that a single source of power may be better for the beginner.

We shall return to this page of diagrams in due course, when we are dealing with track insulation at points, but for the moment these remarks may be taken to suffice.

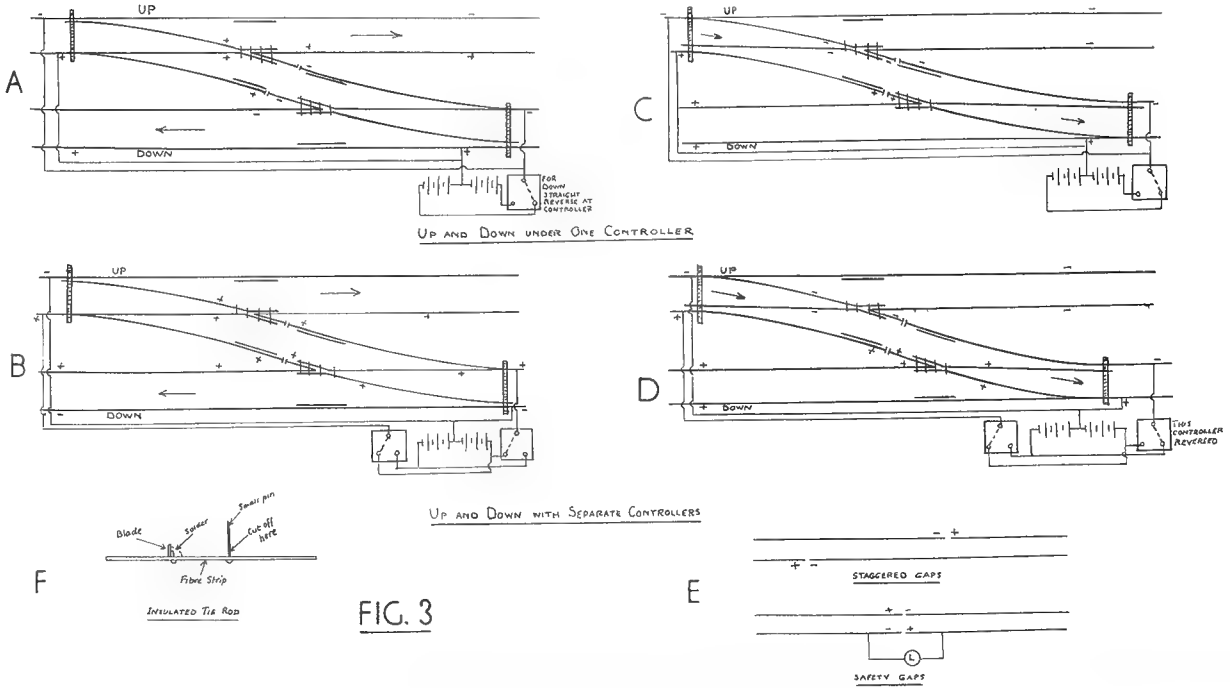

A
UP
DOWN
FOR DOWN STRAIGHT REVERSE AT CONTROLLER
UP AND DOWN UNDER ONE CONTROLLER
C
UP
DOWN
B
UP
DOWN
UP AND DOWN WITH SEPARATE CONTROLLERS
D
UP
DOWN
THIS CONTROLLER REVERSED
F
Blade
Swivel
Small pin
Cut off here
Fibre Strip
INSULATED TIE ROD
E
STAGGERED GAPS
SAFETY GAPS

FIG. 3

THE BEST METHOD IN DETAIL

We shall devote ourselves to the integral-frog method, and the control of current supply through the point-blades, in this brochure, since up to the time of writing this is definitely the best and simplest scheme. It makes point construction easier and more robust; it affords instant and automatic track selection; it almost entirely dispenses with tie-rod slide-switches excepting for purposes other than track-energising; it eliminates an enormous number of section switches on the main board; and it dispenses with two-thirds of the otherwise essential gaps and gap-cutting. Little more need be said in its favour.

Let us, then, dwell briefly upon several axioms to be borne in mind by the worker in using this system, one or two of which have already been hinted at. First, it should be a usual procedure to feed all current at the open end of a point. Secondly, there should usually be a gap at the turnout-side of a point in the straight rail. Thirdly, this gapped section usually needs to be bridged over by a jumper-wire attached to the turnout-side running rail and passing from the open end of the point to the back of the frog beyond the gap. The purpose of this jumper is obvious, of course. It simply serves to continue, where required, the enlivening of the rail beyond the innovating agency of the turnout. Fourthly, there is the question of staggering the position of gaps when these occur at the same place in both rails. In theory, the reason for this is as follows. If both the gaps are opposite one another, when a locomotive runs off one section to the next (separated by the gaps) and if the polarity of the controllers has not been properly attended to, the engine will instantly reverse in direction and will, if allowed, run backwards and forwards, ending up in all likelihood by burning out its armature. Here you have one of those bogeys of which I told you at the outset, concerning which the early advocates of two-rail unduly perturbed themselves, and even then without due effect beyond that of increasing the complications. The truth is that *merely* staggered gaps provide no solution, for when the first wheels of the locomotive pass over the first of the gaps on to the next inch of track at the same polarity, a short circuit will be caused and the fuse will blow. I would therefore advocate the idea suggested by Mr. John Ahern, in which (Fig. 3 at E) about a foot of rail is isolated by gaps at both ends, and is provided with a push-button switch which can be held down while the engine passes over the section. The method may appear somewhat pedestrian and primitive, but it should be remembered that the need of it will only occur where two adjacent sections, like a main line and a yard, meet. If, however, the idea is not relished, a tell-tale lamp may take the place of the push-button switch, and when the polarities are opposed this lamp will immediately give the indication before the train approaches.

So much for rule number four. Fifthly, it is now a standard stipulation that all commercial locomotives are sold under the arrangement that the right-hand rail for the normal direction of movement, when the track is viewed from the cab, shall be positive and the left-hand rail negative. This rule effectively avoids complications arising from the haphazard wiring-up of armatures, and it of course entails that for an " up " road (traffic left to right) the right-hand rail shall be positive, and for a " down " road (right to left movement) the right-hand rail shall normally be ditto.

Sixthly, and finally, all slide-chairs and tie-rods shall be insulated. In other words, even if no chairs are used at all, there must be no live connection possible between switch-rails and stock-rails when the former are drawn away from the latter to set a point, or by way of the pull-rods that operate the blades. The approved method of forming tie-rods is shown at Fig. 3 (F), and it is worth observing that one great feature of the method is that it permits a certain amount of lateral swivelling when the point is drawn.

After careful observation, I am not aware that the conditions for making and wiring o-Gauge track differ very much from those to be applied to oo-Gauge. If scale chairs are used in o-Gauge, then it follows that the slide-chairs must be insulated; and the same rule of insulation applies also to tie-rods unless the switch-blades are hinged in united pairs. In the formation of o-Gauge point-work there will doubtless be less need for the use of any soldering, which is carried out in oo-Gauge mainly for the purposes of strengthening the track, or for ensuring conductivity at a frog, the latter also being usual in o-Gauge. On the whole, when working in o-Gauge, there will be less need of the several expedients required for oo-Gauge, since the components are on a much larger scale and can be operated upon for two-rail in fuller detail.

COMMERCIAL TYPES OF TWO-RAIL TRACK

It might well be our next task to glance over the commercial supplies in the way of track and track accessories. It is a pleasure to be able to record that the market is rapidly becoming most lavish in its provision, so that it is really no longer necessary to consider American supplies, difficult as they were to obtain. For all the gauges we now no longer require to look beyond the ranges of our own country. Excellent ready-made track can be had from Mellor, Hambling, Evans & Co., Walkers of Baker Street, while there are besides these enterprising firms the well-known ERG and the Peco lines. The latter products are really at their present stage most ingenious. I am delighted to be able to withdraw a former remark of mine deploring the somewhat tedious labour involved in assembling Peco track. In its present form, the Peco line is excellent, and can be assembled more rapidly than any other. It is indeed merely the work of moments to make up a full 18-in. length of perfect permanent way. This firm now also retails ready-made track. In view of the fact that at a later stage I propose to give some hints on an inexpensive form of this roadway, I think it would be well to describe the parts, as well as the standard methods, in some detail.

The revolution in labour-saving which has been brought about by the manufacturers of Peco track really centres around the so-termed ballast units which are now on sale. These consist of precision-punched strips of $\frac{1}{16}$-in. cork sheeting, usually flexible, but for pointwork made rigid. The strip is punched to form recesses to take the sleepers, so that these fit exactly in place when the strip has been stuck down on its bed. This means that no spacing is required for the sleepers, and no gauging for the track, since the sleepers are themselves ready punched to take the spikes which retain the rails. My own idea would be to use for a track-base some form of thin wood akin to blind-laths. For a long straight, take, say, a yard of this and cut it to the width of the ballast unit. Glue the underside of the ballast unit and stick it down with the aid of a weight. When dry, lightly rub over the cork surface with a wire brush, to roughen it, blow off the loose grains and paint it to requirements with a flat colour. Diluted Indian ink is good; so also is slighly thinned wagon grey. All depends on the locality of the track. Now glue your Peco sleepers and lay them in the slots. There are two types of sleepers—those suited to the old Peco clip-through chairs and those suited to the new flat-bottom (FB) rail. With the former, you insert the chairs and then, reversing the work, open up and clip over the tails of the chairs. With the flat-bottom type sleepers you don't need to do that; you simply slip the chairs on the FB rail, space them for the sleepers and glue the whole thing down, holding it temporarily in place with pins as in Fig. 5 (D). With the clip

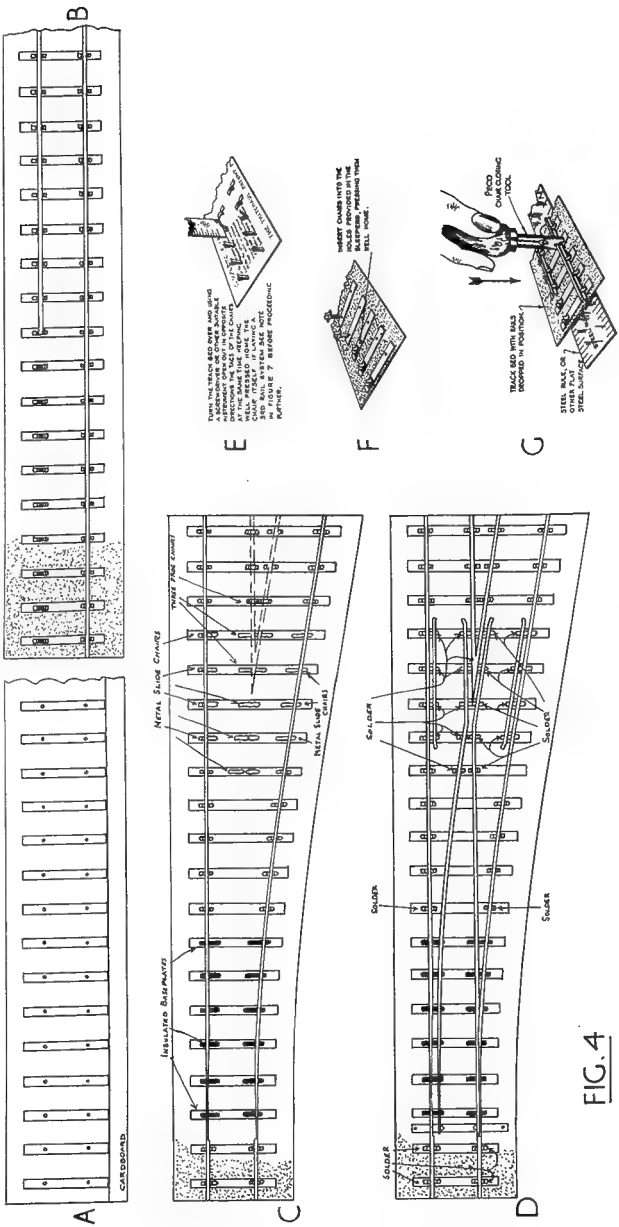

A
B
C
D
E
F
G
CARDBOARD
INSULATED BASEPLATES
METAL SLIDE CHAIRS
THREE FACE CHAIRS
SOLDER
PECO CHAIR CLOSING TOOL
TRACK BED WITH RAILS DROPPED IN POSITION
STEEL RAIL OR OTHER FLAT STEEL SURFACE

FIG. 4

chairs and bull-head rail you slip the rails in the chairs and clinch them with a small pair of pincers. The result, especially with the FB rail, is an absolutely perfect miniature track. The method of clipping the chairs under the base is shown in Fig. 4 at E, and the inserting of the chairs will be seen at F. G shows the special tool for closing the chairs on the rail if pincers are not used. In Fig. 5 at C, you will find the various components for the FB rail type. At B, the slide-on chairs are shown.

The ballast units themselves can be had for either straight or curved track, the latter is numerous radii, and can be instantly manipulated (see Fig. 5 at H) to suit absolutely any form of point required. A good tip is to paint the rail before fixing it.

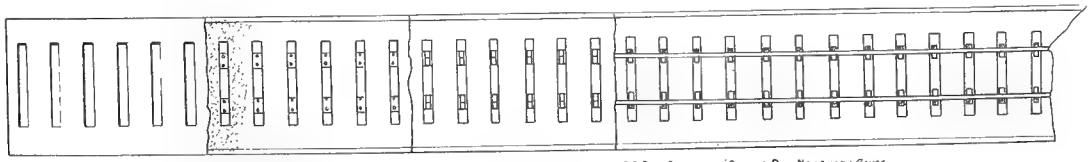
The construction of points under the ballast-unit scheme is greatly aided by the spacing and shape of the units themselves. The sleepers here consist partly of the standard straight-track punched sleepers and partly of the plain sleeper strip supplied in long lengths. The chairs are simply glued down on the tops of the sleepers and secured by correct scale spikes, the holes being made by the worker.

There is another form of standard Peco track-making, and this is shown in Fig. 5 (B). Here, the FB rail and sleepers are used, with the ballast units, all chairs being eliminated, and the rails being simply spiked straight down to the sleepers. The work is thus considerably reduced in cost, and the result is exactly like American track, being quite robust. For pointwork a little recourse may be had to soldering here and there for additional rigidity.

It is worth mentioning that point blades in FB and bull-head rail can be had ready shaped, as shown in Fig. 5 (E). This is a great advantage, and the cost can be covered by avoiding the use of chairs, if expense is an item to be considered. Note that in forming the points, the rails should be joggled with a pair of pliers, or with a rail-joggler which should shortly be on the market. This is a simple instrument which is squeezed in a vice. It is no arduous task, however, to shape up the point-blades oneself.

The spiked method is described in Fig. 5 at F and G, and is exceedingly simple and speedy.

I have always held an admiration for Mellor track, which though maybe not quite so perfect in appearance, the sleepers being rather thicker, is extremely well made and affords first-rate running. Most of the West Midland System is laid with this track. Its snag is that it requires ballasting after completing, but this is not difficult if the base is added last. The whole of the base-strip surface (wood or cardboard) is glued, the track or point pinned down and (before the glue dries, the whole covered with granulated cork ballast, ready coloured. This is pressed down and left to dry, special attention being given between the sleepers. Thereafter, the thing is reversed and the loose cork shaken off.

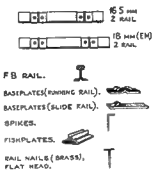

BALLAST UNIT GLUED ON BLIND LATH
F.B. SLEEPERS GLUED; UNIT ROUGHENED AND PAINTED; EDGES CHAMFERED
FOUR RAIL NAILS TO EACH SLEEPER
F.B. RAIL SOLDERED TO OUTSIDE RAIL NAILS WITH GAUGE

A HOME BUILT PECO F.B. TRACK WITH SOLDERED NAILS

B

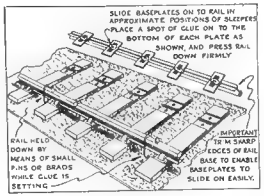
TWO NEW 'PECO' STYLES

C



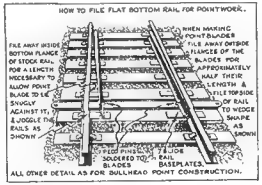
PECO F.B. COMPONENTS

D


SLIDE BASEPLATES ON TO RAIL IN APPROXIMATE POSITIONS OF SLEEPERS. PLACE A SPOT OF GLUE ON TO THE BOTTOM OF EACH PLATE AS SHOWN, AND PRESS RAIL DOWN FIRMLY.
IMPORTANT TO MAKE SHARP EDGES OF RAIL BASE TO ENABLE BASEPLATES TO SLIDE ON EASILY.
RAIL HELD DOWN BY MEANS OF SMALL PINS OR BRADS WHILE GLUE IS SETTING.

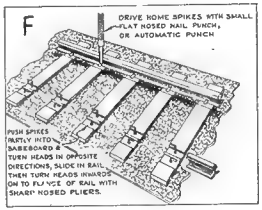
STANDARD LAYING OF PECO F.B. TRACK

E

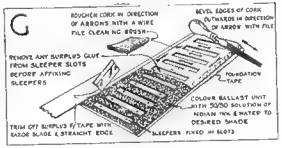

HOW TO FILE FLAT BOTTOM RAIL FOR POINTWORK.
FILE AWAY INSIDE BOTTOM FLANGE OF STOCK RAIL FOR A LENGTH NECESSARY TO ALLOW POINT BLADE TO LIE SNUGLY AGAINST IT, & JOGGLE THE RAILS AS SHOWN
WHEN MAKING POINT BLADES FILE AWAY OUTSIDE FLANGE OF THE BLADES FOR APPROXIMATELY HALF THEIR LENGTH & FILE TOP SIDE OF RAIL TO WEDGE SHAPE AS SHOWN
SOLDERED TO BLADES
RAIL BASEPLATES.
ALL OTHER DETAIL AS FOR BULLHEAD POINT CONSTRUCTION.

STANDARD POINTWORK IN PECO F.B. TRACK

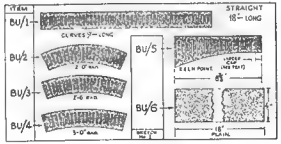
F


DRIVE HOME SPIKES WITH SMALL FLAT NOSED NAIL PUNCH, OR AUTOMATIC PUNCH
PUSH SPIKES GENTLY INTO BASEBOARD & TURN HEADS IN OPPOSITE DIRECTIONS, SLIDE IN RAIL THEN TURN HEADS INWARDS ON TO FLANGE OF RAIL WITH SHARP NOSED PLIERS.

G


ROUGHEN CORK IN DIRECTION OF ARROWS WITH A WIRE FILE CLEANING BRUSH
BEVEL EDGES OF CORK OUTWARDS IN DIRECTION OF ARROW WITH FILE
REMOVE ANY SURPLUS GLUE FROM SLEEPER SLOTS BEFORE AFFIXING SLEEPERS
FOUNDATION TAPE
COLOUR BALLAST UNIT WITH 50/50 SOLUTION OF INDIAN INK & WATER TO DESIRED SHADE
TRIM OFF SURPLUS FOAM TAPE WITH RAZOR BLADE & STRAIGHT EDGE
SLEEPERS FIXED IN SLOTS

H



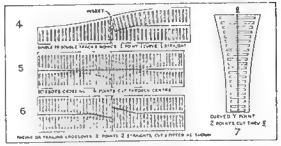
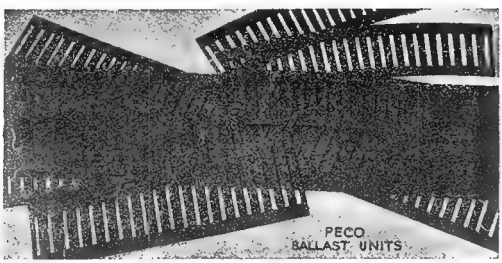


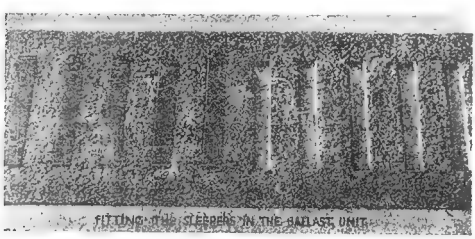
FIG. 5

A good tip for all ballasting of this kind is first to paint the base which will lie under the ballast. A dark grey should be used, and if this is done the finished result will be ten times better. Should there be any spot here or there where the ballast has not adhered, this will not be noticed on account of the paint.

Walkers, Hambling, Bonds and ERG parts for oo-Gauge two-rail track are all to be recommended, and the worker can scarcely complain that his wants are not adequately catered for by the suppliers.

For o-Gauge, any of the better-class scale permanent way lends itself without trouble to two-rail work, as already stated. If I were a worker in o-Gauge, however, I would not consider anything other than the splendid true-to-scale track and parts supplied by Rocket Precision Ltd.





Some examples of Commercial Tracks.

See also Page 64

AMATEUR-BUILT TRACK EQUIPMENT

I know numerous workers who build their own track, not rigidly adhering to any proprietary instructions, and a fine thing they make of it. Mr. Fleetwood Shawe works to a most ingenious combination of standard rail, Walkers' chairs and (I believe) ERG sleepers. My friend the Rev. Neil R. Henderson of Huntly uses ERG sleepers, wire-staples and solder. But I think I can suggest a better and cheaper method than any of these. Sir Eric Hutchison, in o-Gauge, also has his own favourite method. He uses Rocket Precision parts, but employs cardboard sleepers in the main, with regularly occurring ones in stripwood, and for a trackbed uses $\frac{1}{8}$-in. thick book-binders' cardboard. It would be hard to improve on the finished appearance of his work.

But let us consider what I think is the quickest and cheapest of all methods of making up oo-Gauge track; and the parts I would use are Peco parts. The worker can take his choice of using either flat-bottom or bull-head rail.

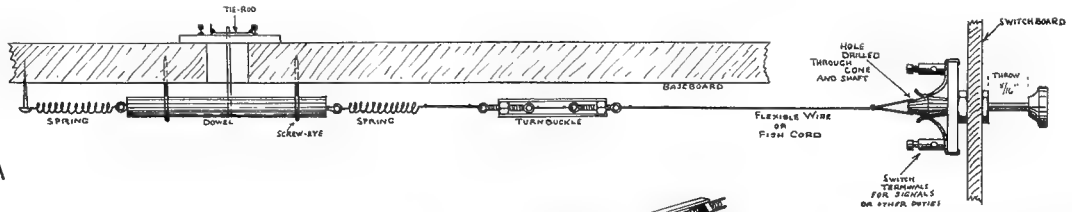
Assuming that bull-head is chosen, the track will be executed in clinched Peco chairs of the old type. If FB rail, then the track will be soldered. For the bull-head, use a trackbed of thickish card (about $\frac{1}{16}$-in. will do), cut to a width of $1\frac{3}{4}$ ins. On this, draw a line for the bottom edge of your sleepers, glue the entire surface with hot, joiner's glue, and set your sleepers in place. Press them with a weight for a few seconds, then sprinkle the whole thing with granulated cork ballast (ERG type). Follow up with a few more such lengths while the first is drying. Then shake off the loose cork. Now take a brad and complete the sleeper holes through the cardboard. Then insert your chairs. Turn the length over and clip the chairs back underneath, pressing the track firmly lest the chairs may fall out meantime. Now lay in your rail and clinch the chairs over it with either pincers or the proper Peco tool. Fig. 4 (A and B) shows the process, A being the sleepers in place and B showing the ballasting done, the chairs in, and the rail laid. You can make up this track at the rate of twenty minutes a length, and its cost is only as much as will cover ballast cork, chairs and rail.

For the FB type of rail, the method is one which I pleaded for long ago, in which the new Peco brass rail-nails are used. Consult Fig. 5 (A) for the method. First we have the ballast unit glued down to the blind-lath, the latter the same width as the ballast unit. Next we have the cork surface roughened, the colouring added and the sleepers (FB type) glued in. Next, two pairs of brass rail-nails are tapped into the prepared holes and through to the lath, the outer edges of the strip having been previously chamfered off with a fine file or sanding block. Finally the tracks are shown soldered to the nail-tops, the outer sides only being soldered. For this soldering you use a wooden gauge-strip. I think this should really work out as the cheapest method of all for those who like soldering.

A few words more as to pointwork in the first of these two styles. Turn back for a moment to Fig. 4 at C and D. Here you will find what I think is a very expeditious method of forming points with the bull-head rail. Proceed mainly as in A, and use a cardboard base. The point is a combination of clipping and soldering. All the parts are standard Peco components. The insulated baseplates are provided for FB rail actually. The metal slide chairs are of the older back-clipping kind. The frog chairs are specially supplied. The places where soldering is desirable are shown clearly in D. Begin by setting in the two stock-rails according to radius required. Then, with the aid of two gauge-strips, set in the frog. The blades are always fitted last; and do not omit the joggling before you start. In the drawing, the rails are shown filed out; but the joggling method is just as satisfactory.

As for insulating gaps, these are easily made. You will be able to form the most prevalent gap of all—that just behind the frog of a point on the same side as the turnout, by simply leaving a space in laying the track, and you can add an insulated fishplate to retain the alignment. But where gaps are needed unexpectedly, these can be cut when the track is laid if you work gently and diagonally with a fine metal saw. The fishplates (insulated) can be added when the tack is laid if you slightly open them out.

The next question seems to be that of how to operate the points when they are in place. This may of course be done either manually or electrically. In the former instance, the scheme shown in Fig. 6 may be of service. It consists in part of what is known in America as the Dechart system, and in part also of an idea of my own, calling into service the common type of push-pull two-way switch. It works from the switchboard and can be carried any length. The appliance is easily made, and can be duplicated in considerable numbers without trouble; it is also very robust in its form, consisting of a short piece of dowelling, two screw-eyes to fit the latter, two spiral springs (to be had commercially), a home-made turnbuckle, some screws, fishing-line and the plug-switch already mentioned. The turnbuckle, which serves the purpose of adjusting the tension of the line if required, is very simple to make from a couple of light bolts and nuts. The bolts are cut behind the heads and drilled at each end; they are then connected together in the middle, with their threads opposed to each other, and the nuts slipped on. The nuts are then connected as shown by means of a couple of soldered strips of metal. The main thing to watch is the strength of the joints where the wire or the fishing-line is attached. The plug of the switch is also drilled for the same purpose. Drill right through the cone when set in place on the thread. The tie-rod pin for operating the point is a length of wire a tight fit in a hole through the dowel. It will be found that the two springs will give the whole mechanism a very sweet movement without any jarring, and that the springs will also compensate for any variation

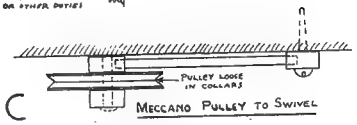


A

MANUAL POINT OPERATION

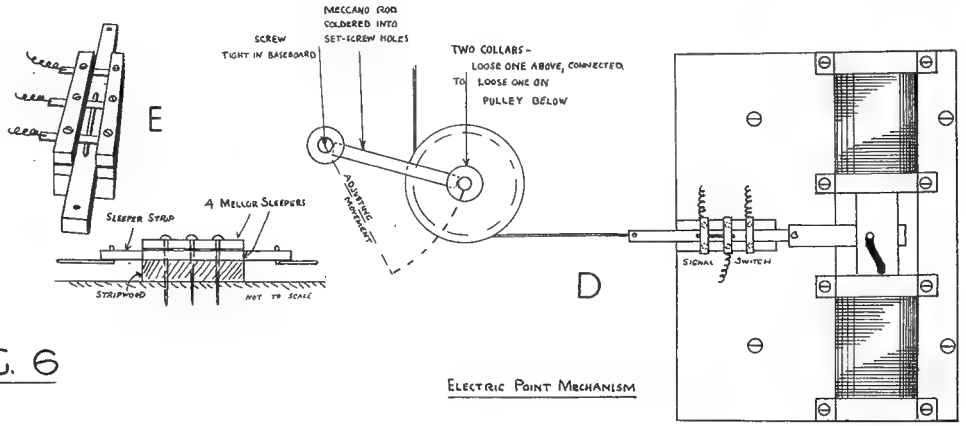
B

SIMPLE FORM OF TURNBUCKLE



C

MECCANO PULLEY TO SWIVEL



E

D

FIG. 6

ELECTRIC POINT MECHANISM

between the throw of the switch and the throw of the point. The switch itself is of course invaluable, and we shall return to it when we discuss signalling.

It will frequently be necessary to carry the manual line around corners, and for this purpose there could be nothing better or cheaper than the ordinary Meccano pulley with its fixed bush, as shown at C. The tension of the springs should be sufficient to prevent the line from slipping off the pulley.

This pulley appliance can be used for electrically operated points at a considerable distance, and for signalling purposes I have introduced (see E) a simple slide-switch of my own design, the making of which is simplicity itself. It consists mainly of Mellor fibre sleepers, four of which are screwed to a bit of stripwood, a suitable length of Peco sleepering being arranged to slide between. On this sliding piece there is a common pin, which is bent like a staple and fixed as shown. This forms a contact between the small phosphor-bronze pieces which are held by the round-headed screws holding down the switch. This switch, again, is intended mainly for auxiliary work such as that of operating signals.

Note that in both these appliances the movement of the point-blades is definitely *locked* in both positions, in the manual machine by the locking of the plug switch, and in the electrical outfit by the Z-shaped slot on the solenoid. This locking of the points is the very first essential of two-rail control and supply, and unless it is secured, nothing will work reliably. But the securing of it is no difficulty whatever. Even a standard point lever, if employed, is invariably provided with a definite lock in either position.

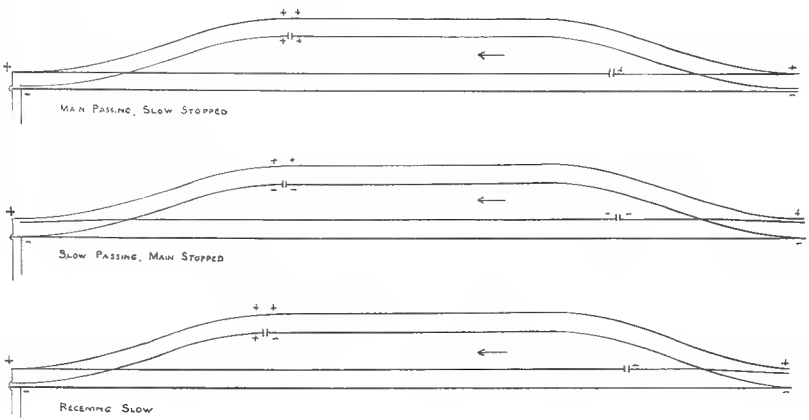


FIG. 7

THE INSULATION OF POINTS

We have now arrived at the most fascinating feature of our subject—the various methods to be adopted in the insulation of all manner of points and crossing formations in order that the current might be supplied, mainly by means of the points themselves.

We will begin with what it seems to me is the simplest and most natural formation next to the single turnout itself, namely the passing siding which is usually installed in order to permit a slow train to draw off the main line in order that a fast train might overtake it, or pass it in the opposite direction. This formation is perhaps the most outstanding example, among many, of the perfect naturalness with which the two-rail system of supply applies to a pair of running rails. The diagrams are given in Fig. 7. The current comes from the controller, as will be seen, to the open end of the left-hand points. The direction of travel is from right to left. In the first diagram it is assumed that the slow train is standing in the siding, facing left, awaiting the passing of the fast train in due course. The points are set for the main line. In the second diagram, the main line is blocked for traffic and the slow train is assumed to be drawing out of the siding. In the third, there are no trains in evidence, but the branch is set to receive the next slow train. The only item to be noted in this formation is that of the two gaps, one behind the frog of each point. With the current reversed, the situation would be the same in reverse order; but if traffic is to run (single line) in both directions the gaps should be placed about centrally in the formation.

Let us now go back for our next subject to Fig. 3, and study the common trailing crossover. This really consists of a couple of twin turnouts simply set back to back. Two gaps are necessary only, midway at the crossing, one in each rail. In B we have the situation where both trains (up and down) are on the straight, running in the normal direction. In D, we have the crossover set and the current so adjusted in polarity at the controller that the up train can take the crossing, the down track beyond the crossing being blocked. All this current adjustment has been accomplished by the movement of the point-blades. The further possible movement at this formation is for one or both tracks to be set for the straight, the current, as required, being reversed, in order that either or both trains may back in the reverse direction. No matter what the required movement may be, however, this wiring will meet the need. It should be observed that the points, of course, work together with one operation of the point-lever.

TWO-RAIL CONTROL

Bonding and Converting a Commercial Crossing

Building a New Insulated Crossing

Tracks to Avoid a Double Junction

FIG. 8

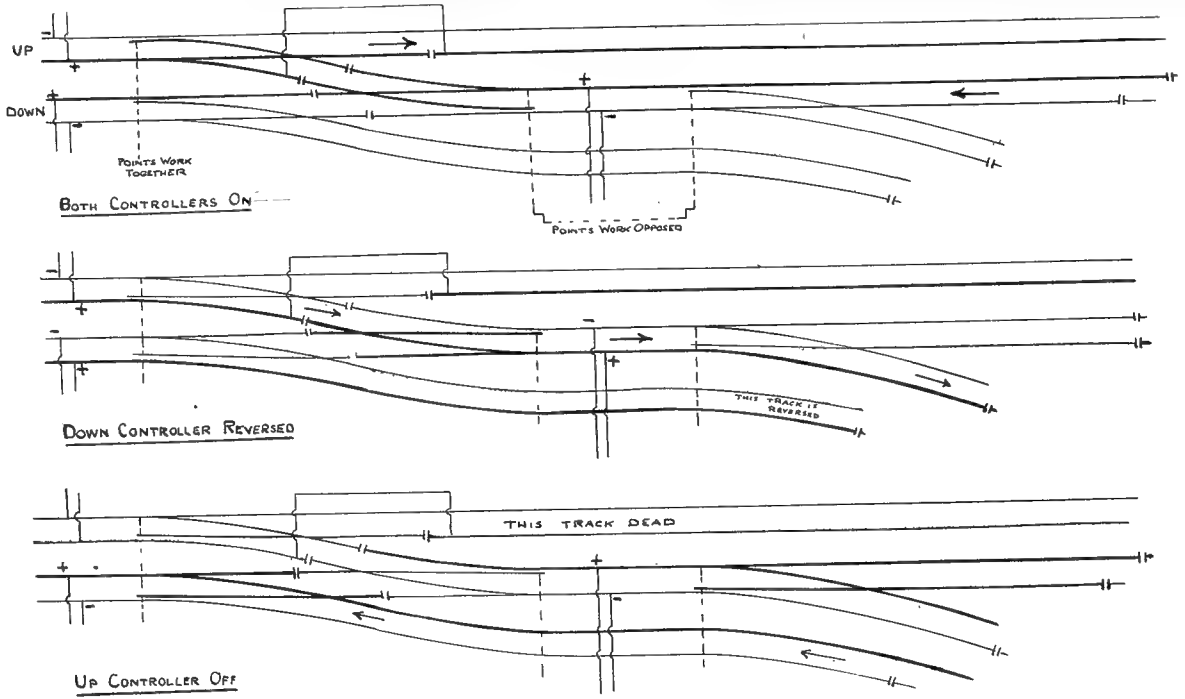
Slightly more developed is the requirement for a double junction. In fact, earlier in the history of two-rail, the double junction was considered to be a ticklish problem. The difficulty was not in the matter of the wiring, but in the fact that the insulation of the crossing demanded, under the old scheme, a considerable amount of doctoring, and this was a serious matter when commercial points were purchased ready-built. In order that working method might be secured under the old system it was necessary to insert small wooden blocks as part of the running rails at the frogs and the knees of the crossing. This is shown in the top drawing of Fig. 8. Altogether, this was not by any means the arduous task that it would seem to be, and the method suggested would be a good one to adopt in converting a ready-built crossing for the purpose. Ordinary chairs are not shown in the diagram (nor their substitute in solder or what-not) but I have tried to indicate exactly which chairs would require to be altered for purposes of insulation, the dotted lines showing those portions of the chairs which would have to be filed or cut out. The chairs that could be left alone are shown as shaded. In building a new crossing, of course, the matter was much easier to get around. The procedure of the lower drawing would then be followed. Wooden blocks the same height as the sleepers could be glued where indicated and the tiny wooden sections of " rail " could be attached with glue and trimmed with a razor and sandpaper.

The insulation of the junction having been accomplished, the wiring would be as in Fig. 9. In the first drawing we have the tracks set for the double turnout (the points working on one lever) and the controllers placed normally for the up or down train, or both, to take the junction. In the second diagram the controllers are unaltered and the tracks are set normally for the straights, the points having been thrown. The third drawing shows both controllers set for the same direction, with points for the turnouts, the " up " train obviously being reversed. The fourth drawing shows the controllers reversed the other way and the points set for the straight, the " down " train here being reversed. The scheme had much attractiveness, owing mainly to the fact that no gaps were required if the rails were bonded with short lengths of wire under the baseboard as shown in Fig. 9.

But I must confess that if this were the only method of wiring the double junction I would rather myself avoid it entirely than struggle with the tricky insulation and thereafter the satisfactory running of the crossing. It is of course quite possible to avoid a double junction while securing all the operating facilities of that formation, by laying the track as shown in the diagram of Fig. 8. And if anyone prefers this method, which is not at all difficult, I have given the two-rail wiring of it in Fig. 10. The scheme involves five gaps (not counting those occurring inevitably at the end of the section), and the rectitude of the current supply under various conditions is determined mainly by the action of the controllers.

FIG. 9

Double Junction with Insulated Crossing



WIRING OF TRACKS TO AVOID A DOUBLE JUNCTION

FIG. 10

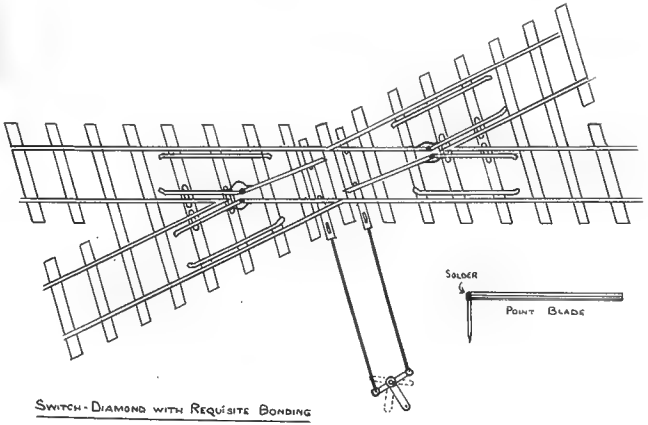
Current is fed at the mouths of the " up " and " down " turnouts and at the midway spot in the middle track. These two adjacent points work by one lever with opposed relations, while the other two points work in unison. There is a jumper-wire from the inner rail of the " up " turnout to the straight rail behind the frog.

In the first drawing, the two straight tracks are set for the normal direction, with both controllers, of course, in service. The second diagram shows the tracks set for the " up " train passing (normal direction) over the " down " track and out to the branch by way of its own turnout. Here, the " down " controller would have to be reversed for the " up " train to pass thus over the " down " track. In the third drawing we have the " down " track set for the normal direction, for trains coming in from the branch, and in this instance the " up " controller is off, the reason simply being that the " up " points are in unison with the " down " points, and this would involve an " up " train in the " down " track reversed current. This would lead to calamity; so the current for the " up " track should be cut out entirely for this movement.

I am thankful, however, to have a better scheme to offer for the working of a double junction than that of the crossing with wooden inserts, and that is the use of a crossing with a moveable diamond, or, as it is correctly termed, a " switch-diamond crossing ". I hope that no reader will instantly think that I am offering one difficulty in place of another; for the switch-diamond is the very simplest of all points to construct and to operate. I give a detailed drawing of this feature in Fig. 11, and the builder of miniature permanent way who cannot make it is by no means an expert. I am commending it here, not merely to circumvent the double-junction trouble, but because it really is so perfectly suited to two-rail work that it must surely be classed as belonging intrinsically to the whole system. It is, in fine, the two-rail instrument *par excellence*, and fits like a glove into nearly every complex formation that can occur, if a crossing is demanded at all. In building it, the one item to make sure of is that the moving blades give full contact, and if this is found to be at all hazardous it will be well worth while to devise some simple spring contact system at the sides of the blades to guarantee what is required. I have no doubt that before many months elapse this switch-diamond will be on sale by all the firms who turn out ready-built track.

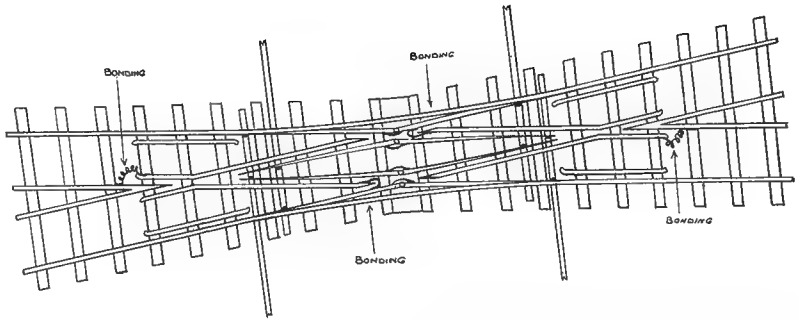
Let us, then, get back to our double junction under this new scheme, and in Fig. 12 you see how it works. Two gaps only are required for the layout, and one jumper-wire—the usual type. There are absolutely no other complications. The diamond operates along with the two turnout points as shown, and the diamond does the work.

It is equally effective, as will be seen in Fig. 13, when applied to the scissors crossing, where, again, earlier schemes involved without exception the building up of a special crossing with wooden inserts. All



SWITCH-DIAMOND WITH REQUISITE BONDING

FIG. 11



DOUBLE-SLIP WITH INSULATION AND BONDING

THE POINT IS THE ORDINARY COMMERCIAL TYPE

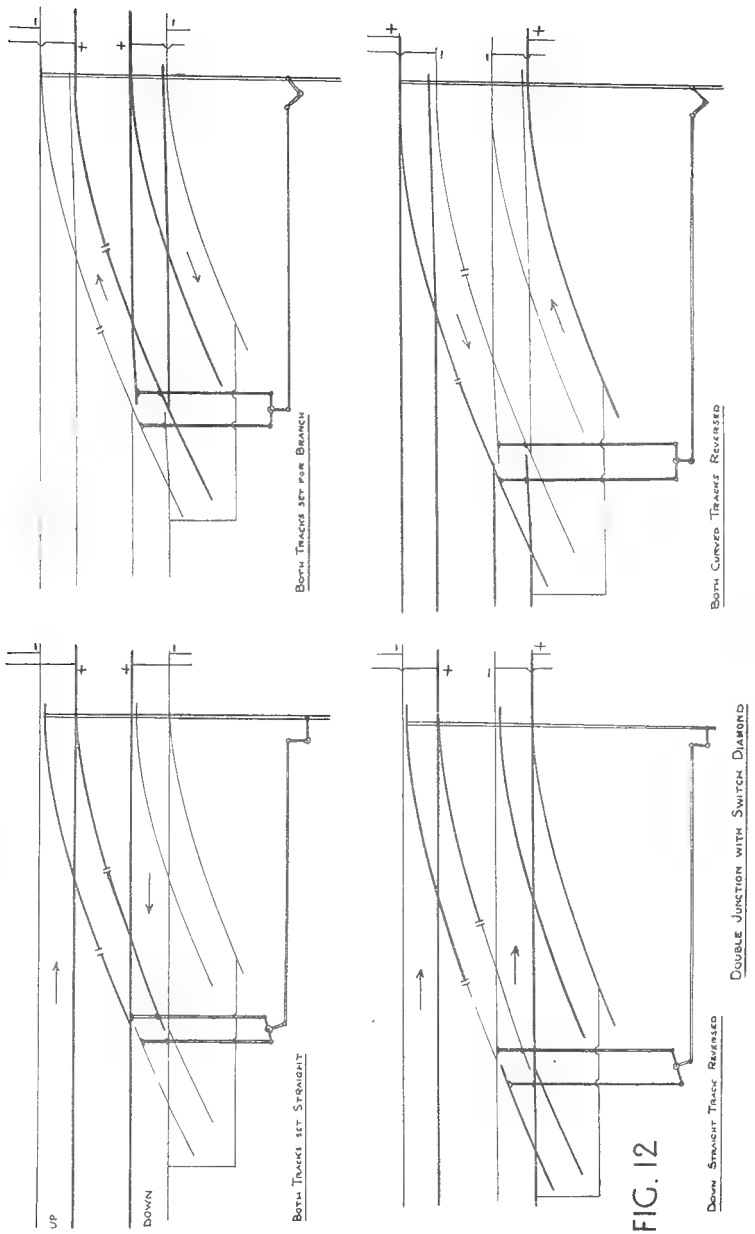
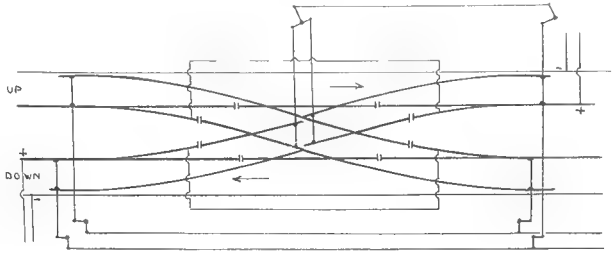
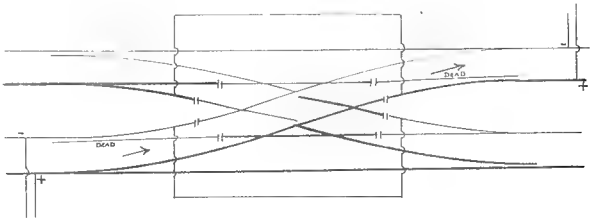

UP
DOWN
BOTH TRACKS SET STRAIGHT
BOTH TRACKS SET FOR BRANCH
DOWN STRAIGHT TRACK REVERSED
BOTH CURVED TRACKS REVERSED
DOUBLE JUNCTION WITH SWITCH DIAMOND

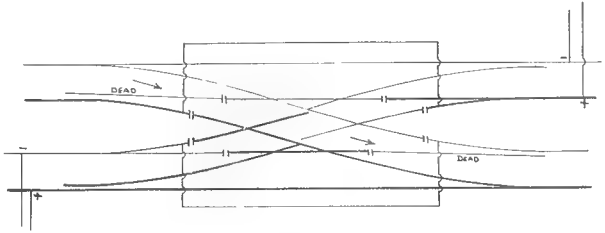
FIG. 12



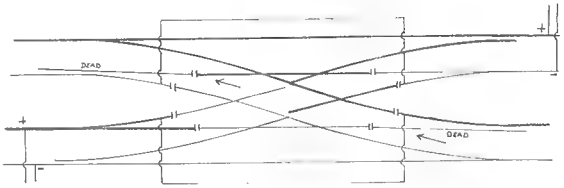
UP AND DOWN FOR STRAIGHTS
WITH POINT RODDING



DOWN TO UP REVERSED FOR CROSSOVER



UP TO DOWN REVERSED FOR CROSSOVER



DOWN TO UP FOR CROSSOVER

FIG. 13

SCISSORS CROSSING WITH SWITCH DIAMOND

+
-
A
B
C
D
B TO D
A TO D
B TO C
SWITCHBOARD DIAGRAM
POSITIVE
NEGATIVE
DEAD
SIMPLE SCHEME FOR SINGLE SLIP

FIG. 14

you need if you use the switch-diamond are two jumper wires and six gaps. The point to remember concerning this form of diamond, also, is that it completely solves the problem of the scissors crossing apart entirely from two-rail considerations. The main reason why the scissors was usually avoided like the plague by two-rail workers was that, even with three-rail, it was a most troublesome combination for trains to negotiate, the awkwardness arising from the breaks in the track at the crossing itself. With the switch diamond there are no such breaks and no consequent need of guard rails with their accompanying trials. And the moving members of the switch-diamond themselves serve to feed or to inhibit the flow of current just where and when such action is demanded. In the diagram I have shown the arrangement I would suggest for the operation of the points, and it should be noted that these operate in pairs opposite each other, the diamond switch being connected only to the one pair as shown. Current is fed in two places, one for " up " and the other for " down ".

Hitherto, the slip-point (single or double) has probably been accounted too tricky for recommendation to two-rail workers. I have no recollection of having seen any instance where an attempt has been made to give diagrams for the wiring-up of this formation, excepting one of my own which appears in *Scale Railway Modelling To-day*, now out of print. In this diagram, which was prepared when two-rail was in its earliest popularity, the arrangement has the appearance of being rather complicated. A good deal of further experiment and thought has produced an exceedingly simple scheme to meet this requirement, and there is now certainly no need whatever to avoid the slip-point as a working proposition in two-rail. As a matter of fact, in using slip-points for three-rail control, I always found them, even in earlier days, very reliable in traffic operation and running qualities, provided that (in those times) wheels having exactly the same clearances were employed. Nowadays, with standardisation in force, this should be no difficulty.

I will deal with the single-slip first, since the arrangements for the double-slip are merely a development of this. The scheme I would now offer is the same in its principle as that in *Scale Railway Modelling To-day*, with the exception of the fact that all tie-rod switches are eliminated, and the manipulation of the current changes is restricted entirely to the agency of the point-blades. Turning back to the lower drawing in Fig. 11, we have the form of the slip-point to be used. It is absolutely standard in its style and structure, and is of the type sold ready-built commercially. In the diagram I have shown the necessary bonding where it must be arranged at four places, and it should be noted that there is no insulation, but full conductivity, through the pivots on which the blades swing. The points for the curves work in unified pairs, as shown in Fig. 14, which gives the single-slip wiring. I think the reader will be startled by the

FIG. 15

Simple Scheme for Double Slip

Diagram for Switchboard

simplicity of the whole thing. Briefly, it consists of four small " on-off " switches of any approved type on the switchboard, with a label over them as shown in the lower right-hand corner of the page. There are three movements of the point possible—B to D, A to D, and B to C. The shaded circles indicate which switches to operate to secure the current. The " dead " rails under possible movements are shown hatched.

With the double-slip (Fig. 15) the arrangement is equally simple, the method being the same. Here, however, there are four possible movements, as the switch-board label reveals. I ought to mention that in all these diagrams I have purposely omitted all gaps excepting insulation gaps, which are shown. Thus, the gaps or spaces which occur at a point for the passage of wheels are never shown. When they occur in the actual point, of course, the place where they do occur is bonded, usually through the check-rail and guard-rail chairs, in the ordinary way.

It is an evidence of the truth of what I have written earlier about the over-complicated designs of earlier days, that this double-slip is on exactly the same arrangements as the one in *Scale Railway Modelling To-day*. All the extra wires and switches in that old design were provided to avoid reliance on the point-blades. But there is actually no need for the blades of a point to be less reliable than the contacts of a switch, if the point is reasonably well made.

In Fig. 16 I have given one or two details of the relationship of these slip-points to other formations as they will occur in a layout. But these relationships really add no problems whatever. If they lead into dead-end sidings or roads which ultimately terminate in section gaps, there is no need of any further gaps at the extremeties of the slip-points. Should they lead to or from other points then gaps will be necessary, the other points from which the slips are thus separated being operated in their own way.

In the instance of gauntleted track the two-rail principle applies itself. All that is necessary is to provide four gaps at each frog and to bond over the frogs themselves, the " up " running rails being of course kept insulated from the " down " rails, as in Fig. 16.

In Fig. 17 we have the through-road arrangment of points, wherein two outer tracks are connected by a crossover through a middle track. This track arrangement often comes into use at wayside factories, where the correct double-track arrangement is adopted, as shown in the line-diagram at the lower right. Sometimes it is needed for a coach siding also. The arrangement is perfectly straight forward, involving five gaps, a jumper-wire and a switch-diamond. Note that the current is fed at three places, from an " up " controller, a " down " controller and a yard controller. The point-operating arrangments are also given. In the top left-hand plan all tracks are set for normal straight movements; in the top right-hand plan the " up " road has been reversed; in the lower left-hand the points have been set for backing from the " down," through

GOODS SIDINGS
COACH SIDING
UP
DOWN
UP
DOWN
SLIPS IN RELATION TO ADJACENT FORMATIONS
-
+
+
-
GAUNTLET TRACKS

FIG. 16

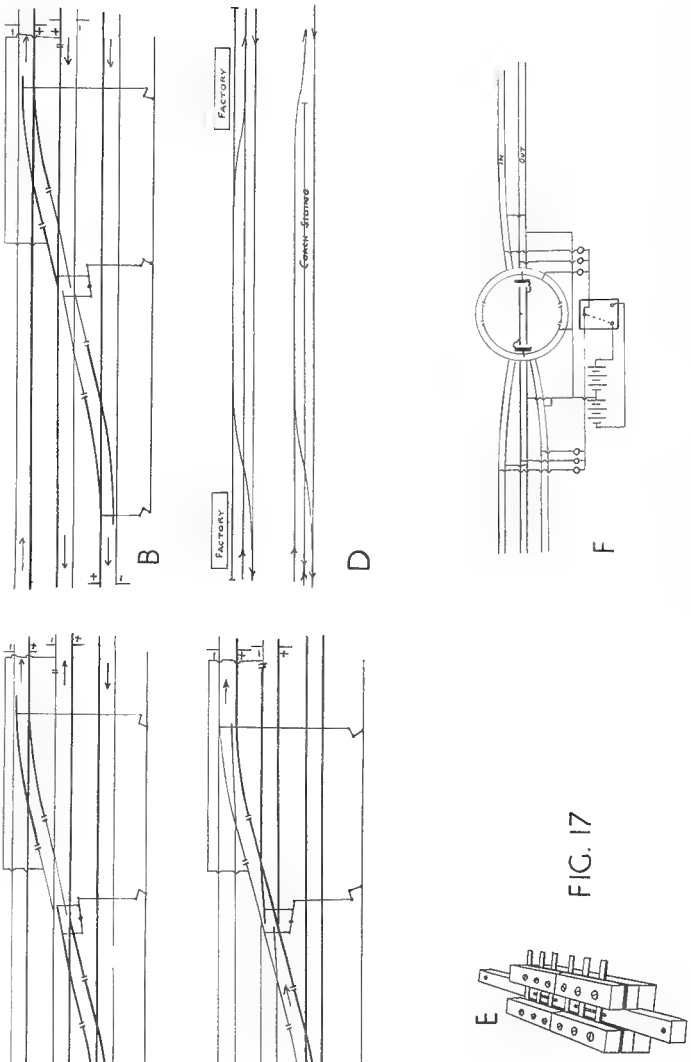


FIG. 17

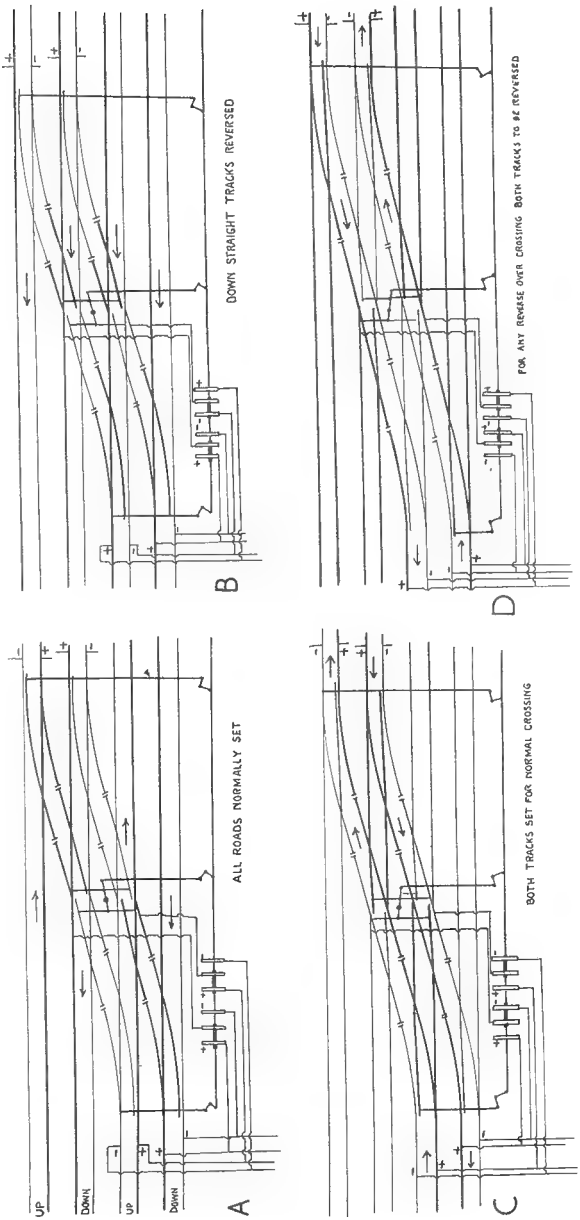
the crossing, to the siding. There are no switches.

The double through road, employed, let us suppose for the passing of trains from a continuous to a terminal run, where double track is in use, is a little more involved. But when I look at this drawing (Fig. 18) and compare it with the enormous complication of switches involved in exactly the same track arrangements for three-rail on the old West Midland, I am amazed. Instead of the two point-rod switches shown here, on that early layout there were eight, though it must be admitted that signals also were included. The arrangment here is extremely simple and entirely automatic in its action. The type of slide-switch required for the point-rods is a development of the ordinary three-contact switch already described. Here, however, there are two sets of these contacts. A sketch of it is shown in Fig. 17. It consists of a block of stripwood for the base, eight Mellor fibre sleepers which are ready drilled as required, a length of Peco fibre sleepering with a couple of bent pins inserted, six small strips of phosphor-bronze and a dozen thin screws. The strips of bronze should be drilled for the screws, and the whole thing can then be assembled in a moment. Four of the screws should be long enough to reach down into the baseboard. The wires are tacked with solder to the projecting contacts, and the whole switch is a tiny affair about 2 ins. long.

Apart from this switch the arrangements for the double through road seem to demand no further elucidation. Note that current is fed in four places, but probably from only two controllers—one " up " and one " down." There are eight gaps, all usual as at crossovers. There is one important proviso in connection with the operation of the formation; for any reverse movement over the crossing, both controllers must be reversed. This could have been averted by the introduction of a second set of switches, but it was not accounted to be worth the trouble.

The wye or triangle, which will occur in some form or another where a main line turns off into a peninsular section of the layout, is very plain sailing; Fig. 19 portrays it. Four gaps and a jumper are all that will be required. Current is fed in two places. Points all operate separately. In Fig. 19, A shows the setting of the tracks and current for leaving the left-hand stem of the wye, B shows the right-hand stem set for traffic, and C the straight.

A quite possible requirement on a fair-sized double-track layout would be that of the double triangle (Figs. 20 and 21), and while the diagrams are necessarily somewhat full, there is nothing very forbidding about the arrangement. It must be remembered, of course, that, as in the instance of three-rail control, the more the points are multiplied, the more work there will be in the wiring of them. The formation of the double triangle involves fourteen gaps and three switch-diamonds, with three jumper-wires. The point operation is also a matter for careful craftsmanship. This is shown in C of Fig. 20. It will be seen that each



DOUBLE THROUGH ROAD FIG. 18

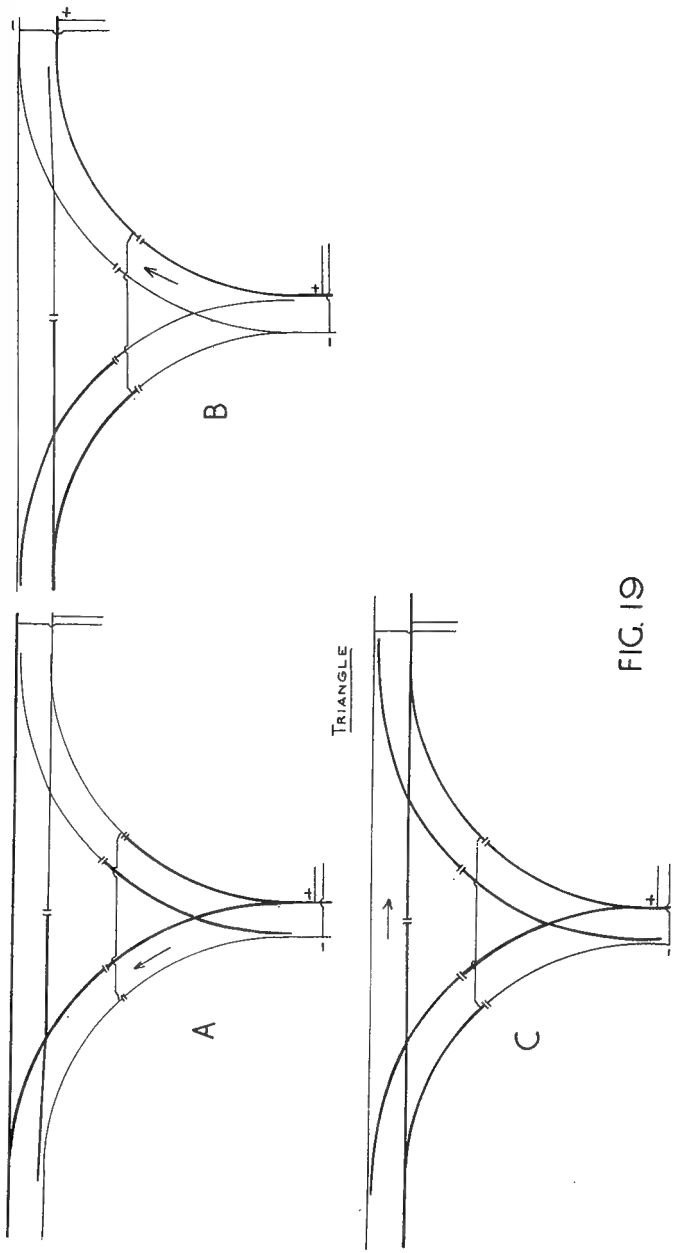


FIG. 19

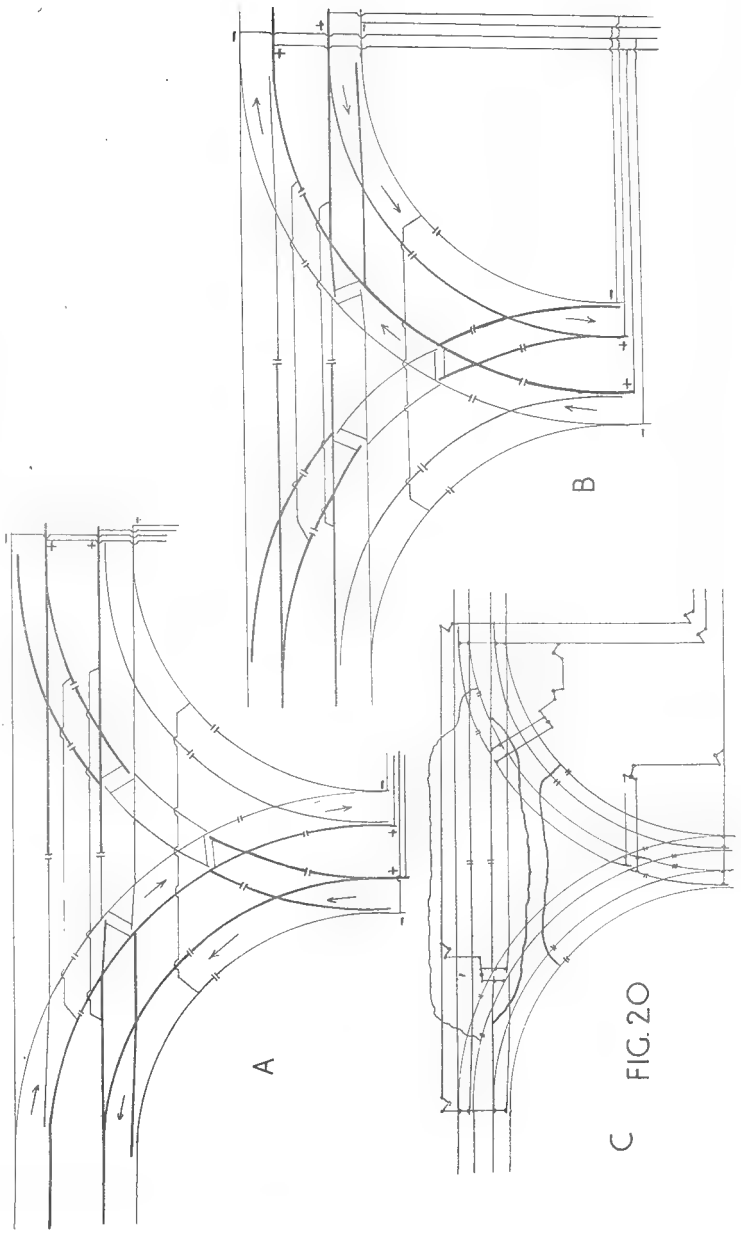


FIG. 20

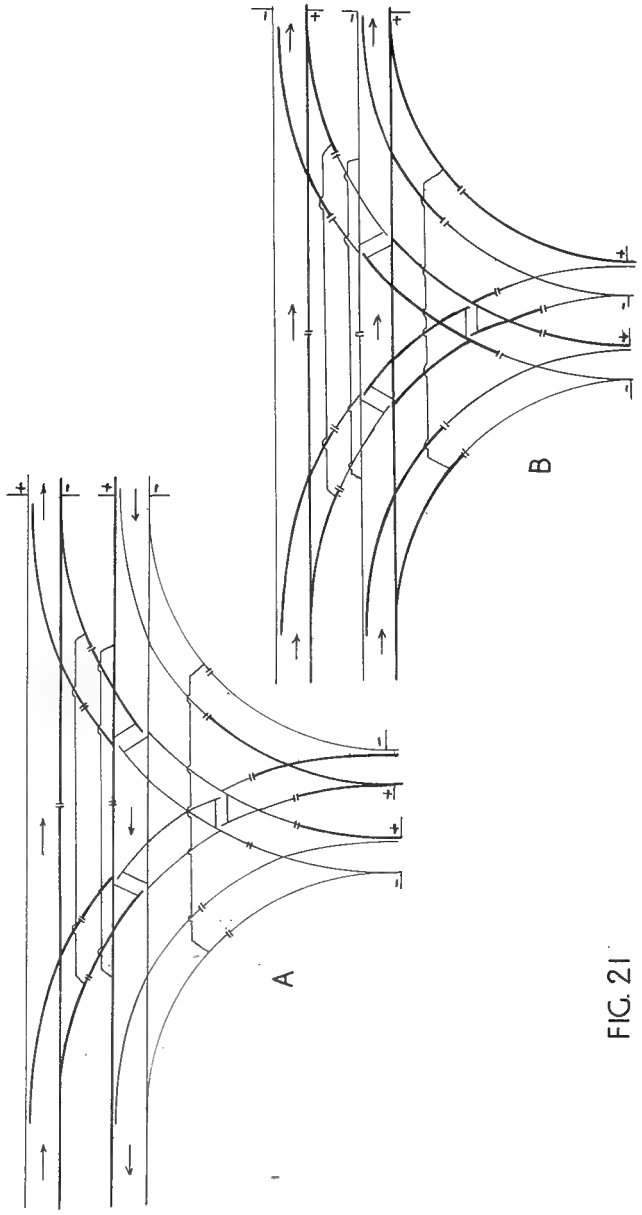


FIG. 21

pair of turnouts works in unison and is linked up with the nearest switch-diamond. The method of supply in itself is plain sailing and involves no switches of any kind. Note that, as with the single triangle, the current is fed in two places and comes from one pair of main controllers (B). A shows the effect of setting the points for the left stem of double track; B shows the right stem, in both instances normally set. A of Fig. 21 shows the two straight tracks ready for traffic, and B shows the " down " track reversed.

The avoidance of a double triangle is quite practicable in the ordinary way, by means of a plain combination of standard commercial turnouts (see Fig. 22 at A). This formation consists of a single triangle and a couple of crossovers, one trailing, the other facing. It should be borne in mind, though, that this arrangement is very extravagant of space, and would require for ordinary 3-ft. radius curves a length of at least 9 ft. It is, however, to be commended for a location where enough space is at liberty, since it certainly involves a great deal less work. It requires, as will be obvious, that the branch shall be single line.

By the simple use of crossovers, the two forms of through road formations can also be avoided (as at B); and the further advantage of this arrangement is that the effect of slip-points is secured in addition. But here, again, the alternative must be chosen at the cost of considerable additional longitudinal space.

The reverse-loop (single track) is really child's play when once its principle has been grasped; but the principle is somewhat elusive. I remember spending many hours puzzling over an American diagram, which, after some weeks, I found to be perfectly correct, but for the fact that the location of the feed-wires had been omitted, and I was working on a mistaken assumption. Note that the current is fed on the loop itself, and not at the mouth of the point. From here, it is fed to the point by way of a double-gang slide switch of the type already described. The train approaches the loop by the straight track, which will be energised as shown in C. T marks the train, and when the engine has reached this point of the loop the turnout is thrown with the result shown in D. The scheme can be used for travelling in either direction. Observe the placing of the two gaps, only one rail being involved.

Provision for wiring a double-loop of this nature is quite redundant, for a double-track loop is entirely useless from the ordinary standpoint, simply serving to do the work of a single-line loop with two ends.

A word about turntables and engine-house tracks. For the empowering of the latter, of course, there is nothing else for it but a separate section switch on the switchboard, unless some form of wipe contact is attached to the turntable and energises the one road required as the turntable comes into line with it. The controller is then set in and the engine moves out of its now-energised stall. The arrangements for an appliance of this kind are simple enough, but hardly come under our

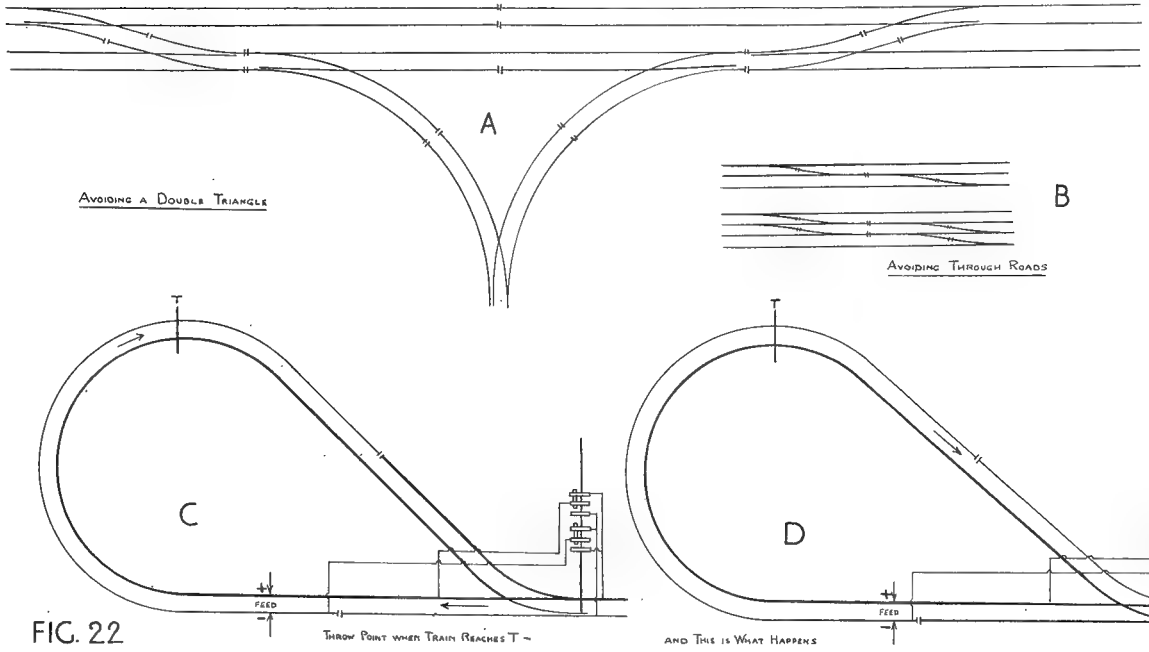


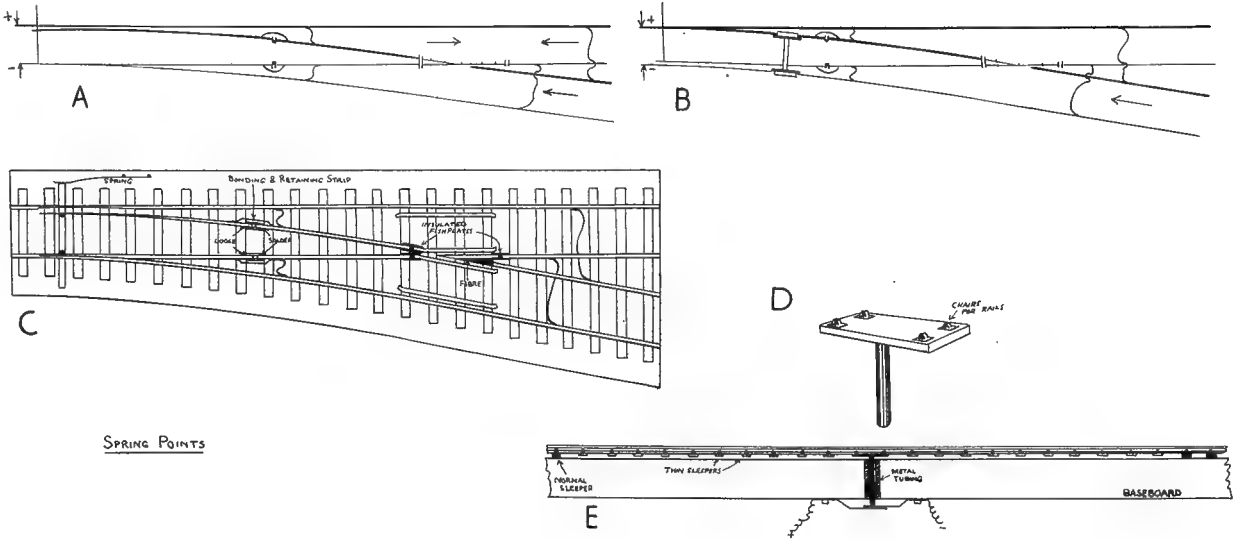
FIG. 22

Reverse Loop

purview at the moment. There is, however, one interesting idea which was given some months ago in the *Model Railroader*, which I give in a slightly altered form in Fig. 17. Here, the turntable itself acts as a reversing switch when turning upon a circle of conductor rail which is broken in four places, two of the four sections thus formed being dead. The current for the turntable tracks is collected in any suitable way (here by way of two wiper-contacts) from this conductor rail in the well. The advantage secured is that an engine approaches funnel-first on the " in " road and on to the table. Here it is turned with its funnel facing the right. Then, without any reversing it passes backwards into the stall aligned for it, and is ready to leave funnel-first when required.

There is something to be said in favour of the use of spring-points on a layout, where it is desired to secure the operation of branch trains on a single track in one direction only, where the single track joins a main line. The need may also occur at other places. These appliances permit the entering of a train in a trailing direction without the agency of any point lever or electric point operator, and thereby save expense as well as operational care. A spring-point is shown in Fig. 23 at C, the making of it being fraught with little trouble. The line diagrams A and B give the conditions of insulation and bonding, the first showing the point as set for traffic. It is available for trains in both directions on the straight, and for the trailing direction on the curve. In B, the wheels of the train from the curve have pushed over the blades against their light spring control, and the spring can be arranged so that the very lightest vehicle, as well as the heaviest engine, will push the points against it. This spring is soldered to two pins (C) and sits freely on the end of the tie-rod. In making the point, the frog is entirely insulated and is left always " dead." It must therefore be shorter than the wheel-base of the shortest power-unit to negotiate it. The diverging rail forming the V of the frog has a different form of insulation—it is separated from the frog by means of a small block of fibre glued between the other V-rail and itself, and trimmed with a razor and sandpaper. It must also of course be insulated at the chairs. The frog should be aligned by using insulated fishplates. Between the frog and the point-blades there is also another broken section, but this is joined by fishplates which are soldered on one end and open on the other. They should be bonded with short strips on the outside of the rails which will serve to prevent the blades from slipping out of the fishplates where they are left free. The other bonding is clearly shown and A and B give the condition of the current under operation—the current, strangely enough, remaining unaltered before and during the passage of a train.

It is quite possible to make the operation of a reverse loop, as well as innumerable other point formations, entirely automatic and independent of the agency of the hand and the memory. This is done by introducing a form of treadle, which, when a train passes over it at the



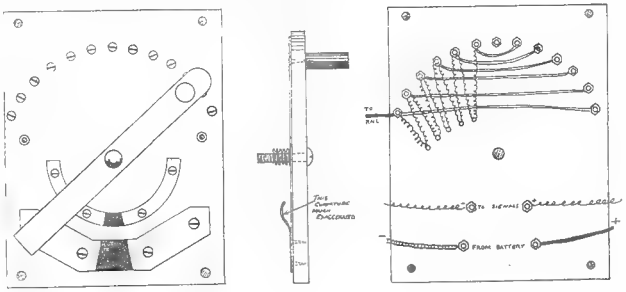
SPRING POINTS

TRACKBED SWITCH

FIG. 23

desired spot, operates the electric point mechanism. In the case of the loop, a second treadle could be placed outside the loop on the main line to ensure that the point was set for incoming trains. Such a treadle, in two-rail, cannot be worked or designed as in three-rail, where a short break in the track is introduced for the purpose. But it can be admirably arranged as at E in Fig. 23. A short length of the track is provided with thinner sleepers than the remainder of the track. The thinner sleepers are chaired up to the rails in the usual way, and it will be found that they allow the slightest depression of the track when a train runs over it. About the centre of the section, two sleepers are omitted, and the plate D is substituted and chaired to the rail. It has a projecting peg which operates through a piece of tubing glued and inserted in the baseboard. This peg, in turn, presses together a pair of contacts. A treadle-switch of this kind will be found useful in a number of ways involved in electric control.

Much has been said in this and earlier sections about controllers. In the handbook on *Three-Rail Control* I have given the design of a standard type of instrument. There is, however, a refinement which can be added to the ordinary controller which will come in very useful when signalling is undertaken, and I will describe it here. Fig. 24 gives the front, side and rear arrangements. The controller is very readily built at home, including as it does nothing other than a piece of plywood for a block, numerous small BA bolts and nuts, a couple of striaght cup hooks for stops, several pieces of shaped thin brass and a piece or two of fibre to go between the contact plates (shown shaded). The resistance wires consist of electric fire elements. There is also a short spring, which can be formed of piano wire, to go behind the lever. The controller can be made to any convenient size, the smaller the better, so long as there is space for the resistances. The additional feature in this instance is the extra switch contacts which can be used where nothing else will serve for the operation of such items as single line signal solenoids requiring an alternative " up traffic " and " down traffic " energising.



SPLIT POTENTIAL CONTROLLER
WITH ATTACHED SIGNAL SWITCH

FIG. 24

STOCK INSULATION AND CURRENT PICK-UP

Special Work on Locomotives

It follows that in two-rail all the wheels of all locomotives and rolling stock must be so insulated that no current can pass from one rail to the other by way of the wheels. On bogies, both on locomotives and stock, the wheels must be further insulated so that they do not form contact with the bogie frames, if these are of the outside journal type. It is customary on engines to insulate only the wheels on the left-hand side, though there are instances where all the wheels are insulated and pick-up is provided on both sides. These, however, are instances of rare occurrence. When the engine wheels on the left side are insulated, the opposite wheels, and from them the whole framework of the unit, are in electrical contact with the right-hand rail.

There have been many different methods of insulating locomotive wheels. For many years the only reliable way was considered to be that of insulation at the hub. It was an elaborate and tedious task. Since this procedure is now entirely unnecessary there is no need to dilate upon it; it has been completely out-dated by the procedure of insulating wheels at the rim. This type of wheel can be bought commercially for the smaller gauges, though most workers in o-Gauge, I believe, still adapt their own. The idea is shown in Fig. 25 at A. The insulation, it will be seen, consists of a thin strip of fibre inserted between the tread of the wheel and the spokes. For the smaller wheels on an engine, many workers still prefer to insulate at the hub, by drilling a hole so much larger than the axle that it will take as a tight fit a collar of vulcanite or other similar material. Hamblings have a special type of engine wheel which is a very good insulation job, and commercial wheels for locomotives can be had from Walkers and several other firms dealing in oo-Gauge.

If the locomotive has a tender, there is no need of any other form of current pick-up than to insulate the left wheels of the engine and the right wheels of the tender, collecting positive and negative straight from the engine and the tender frames. Where this is done, however, the tender must be provided with an insulated form of coupling, so that there shall be no contact between it and the engine unit. The best type of coupling I have seen is that designed by the Mantua Metal Products Co., which is illustrated in Fig. 25 at C. Here you have both the coupling and the jack connection for the lead taken from the tender. The whole thing is simplicity itself, the jack slipping to a hatchet-like clip which securely holds it in place. Another good device is that of the dress snap-fastener. For a different form of coupling, see Fig. 26. It follows, of course, that the tender bogies must not have contact with the metal body of the tender; but this is easily provided against by insulating the tender wheels

as if they were wagon wheels—that is, by means of insulaxles and insulaxle washers, of which more later. Turning for a moment to G (Fig. 25), the arrangement for the insulation of a tender-type engine is shown, while at H we have the method for a tank engine. In this latter instance there is nothing for it but to fit some form of current pick-up to take the current from the rims of the insulated wheels. A good, approved way of making such an appliance is shown at K. It consists of phosphor-bronze collectors shaped as at J, which are attached to the frames, through fibre insulating blocks as indicated at K. If it is desired to have all the wheels in contact and in service for current collection, the fitting can be duplicated. In J, it has been applied to wheels on both sides; but this is unnecessary where only one side is insulated. When fitting the small brushes to the wheel rims, see that they engage more or less at the tips, so that they will thereby introduce a scraping effect on the rim. This will keep the treads clean.

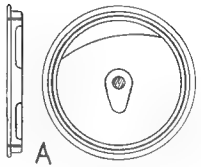
For rail-cars such as Sentinel coaches, one lead is taken from the frames of the mechanism, through the uninsulated wheels on one side, and the other from the rims of the uninsulated wheels on the opposite side of the bogie (trailing). For the latter, a good form of pick-up can be fashioned much as before.

Special work on Stock

The insulation of vehicle wheels, other than engine units, is a different matter, and this has been really revolutionised by the introduction of Peco insulaxles. There are, however, other methods still in vogue which are very satisfactory. Some of these are shown in Fig. 25. At D, we have the solid type of bakelite wheel—solid, that is to say, in that it is of bakelite throughout, though duly spoked. These are sold by Hamblings, and the only fault I ever found in the early ones was that they were very slightly large in the flange, so that on some forms of chaired track they tended to bump slightly on the chairs. No doubt this fault has now been remedied, especially since the Standards Bureau dimensions were made public. At E, we have the metal wheel of the ordinary type fitted on insulaxles, which themselves provide all the insulation required, if a small washer of fibre is inserted at one or both ends of the axle where this engages the journal. F shows the McMurdo wheel, which has a perspex centre and spokes with metal flanges and treads, and gives a very satisfactory service. In this instance, of course, the axle is metal. Any of these types can be fitted to wagons and goods stock.

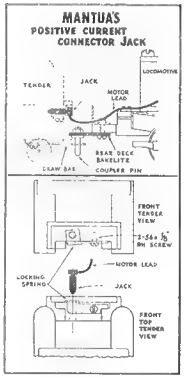
I would also recommend the insulaxle method for the bogies of metal coaches, the use of these, with washers, eliminates the need of worrying about any other form of unsulation at the pivot. If the axle and washers are fitted, the current cannot pass to the bogie frames at all, and therefore the bogies are dead.

Peco wheels can of course be obtained ready fitted on insulaxles, but if it is desired to fit other types of metal wheels to these axles, this will demand a slight dismantling job. Though I have described it elsewhere

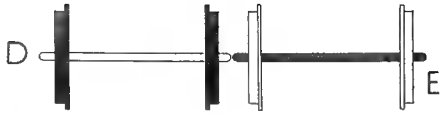


INSULATED LOCO WHEEL

HAMBLING LOCO. WHEEL

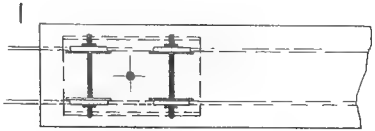


INSULATED TENDER COUPLING AND JACK

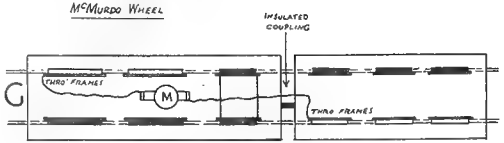


BAKELITE WAGON WHEELS PECO INSULAXLE

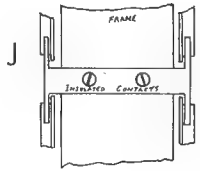
McMURDO WHEEL



INSULATED BOGIE WHEELS

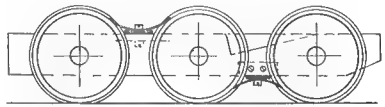


LOCO INSULATION WITHOUT PICK-UP



PLAN OF PICKUP

TANK LOCO. INSULATION



DUAL PICKUP ARRANGEMENT

FIG. 25

in this series, I believe, it is well worth while to repeat a description of the handy wheel-gauge which was made for me by a machinist friend. It is shown in Fig. 26, and must of course be a precision job, though the only vital dimension is that shown. It consists of two members, which are slipped over the axle and are held together by means of two pegs. Wheels can be pushed on or off by using a vice and a Meccano pulley having a boss on it, the spacer being between the wheel backs.

Buffer Stops

If insulaxles and washers are used on coaching stock, the only insulation of buffer stops required is that shown in Fig. 26—namely, at the track ends. Here, gaps can be left as indicated, or the rails can be joined with insulated fishplates. There should be no current at the buffers.

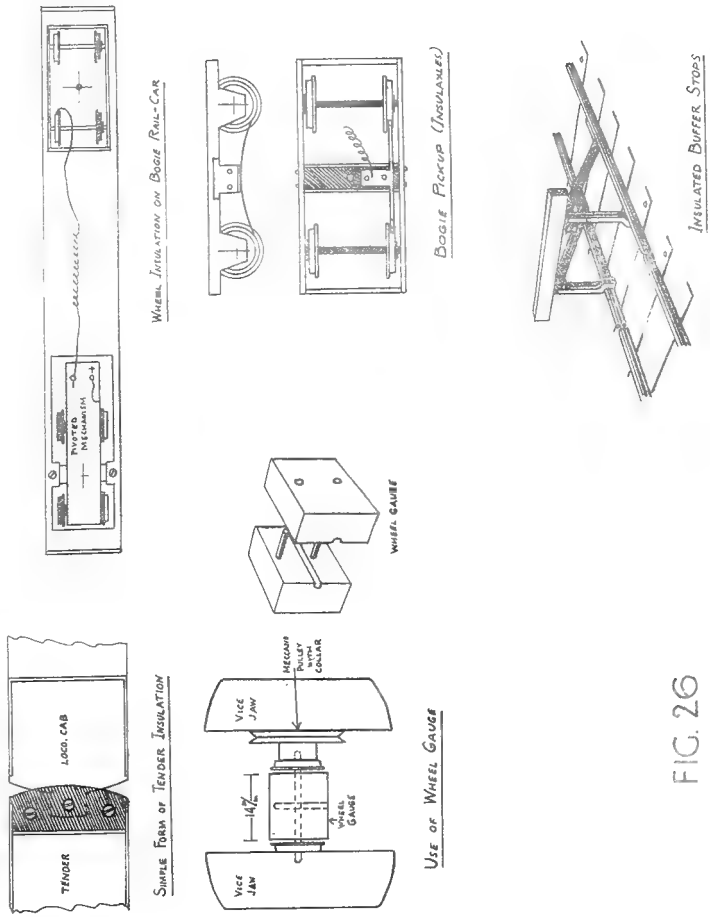


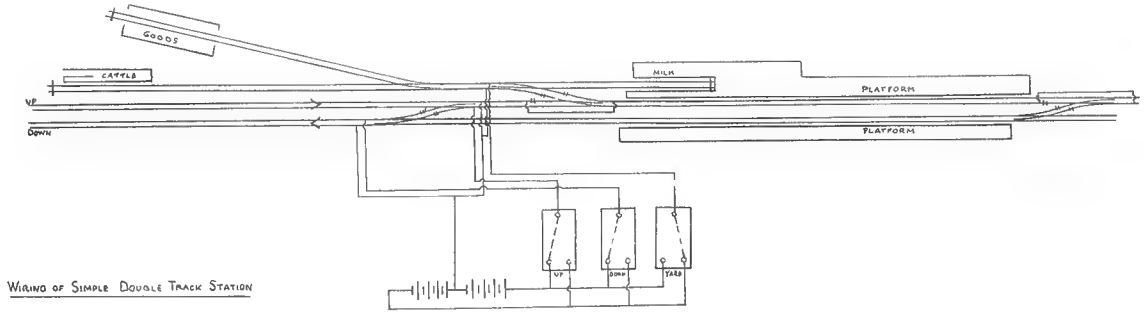
FIG. 26

TWO-RAIL APPLIED TO LAYOUTS

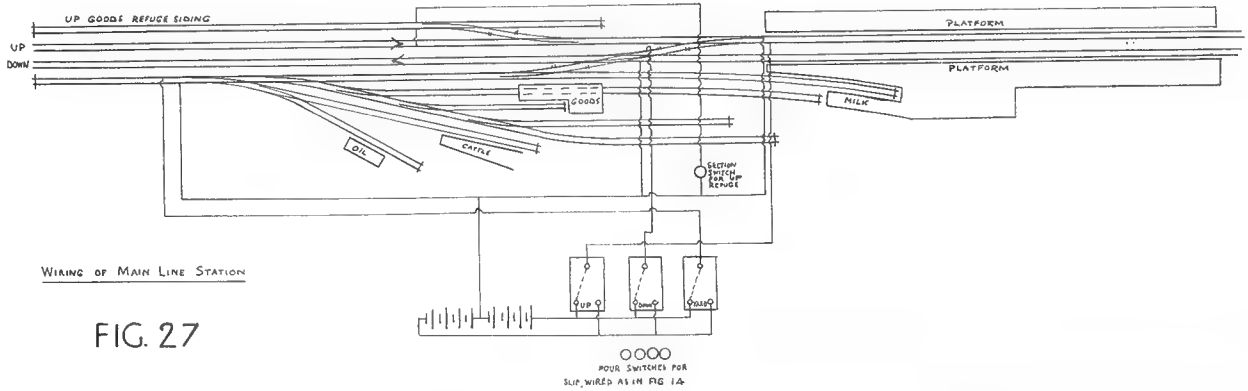
It may be of help and acceptance to beginners to have some idea presented as to what is involved when we pass beyond the mere " point formation " and get down to the main line and to the layouts of small or large stations. While it is impossible, of course, to cover an extensive ground in this connection, I have given two or three diagrams which should afford sufficient guidance to start off with. The top drawing in Fig. 27 gives a wiring plan for a simple double-track station, three controllers being involved—one for the " up " road, one for the " down " and one for the yard. It will be seen that for this station, beyond the usual gaps and a couple of jumper-wires, there is nothing in it. Nor is there much more involved for the larger and lower plan. This station happens to include a goods refuge siding on the " up " track, which is wired in with that track controller, and is provided with a small section switch. There are no jumper-wires, and very few gaps. The yard is separately controlled, so that express main line trains may operate while the yard is also in service.

The question of what shall be done between stations depends entirely on how many sections the main line is to be divided into. For myself, unless for some special passing loop or factory, I would have none, and would simply link up the entire main line as a whole, " up " and " down " alone being separated. This does not exclude the need of providing at given places additional feeders from the controllers, so that there may be no loss of voltage due to length of track. In Fig. 28 we have two adjacent stations with the intervening track wiring and all arrangements given. The dead siding on the lower station plan is optional, and is here linked with the " down " track as distinct from the yard below on the " up " side of the layout. It is provided with a section switch of its own, since the road will be used exclusively by " down " passenger trains, and could thus provide a good passing loop for fast traffic.

In all these plans, of course, reliance is had absolutely on the satisfactory locking of points and their control of current in themselves. But this can be secured just as readily, with care, as any other kind of appliance can be satisfactorily installed.

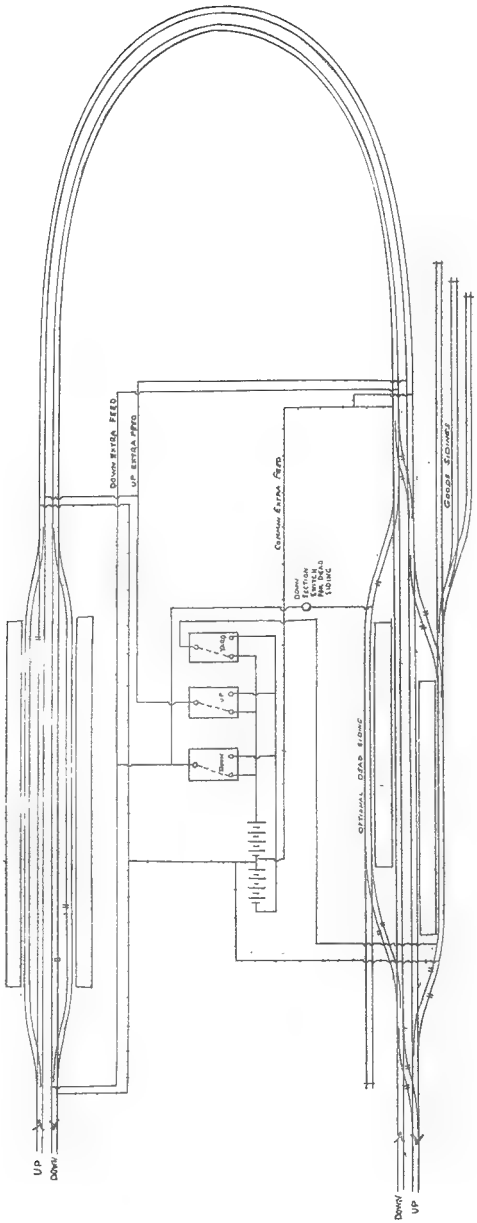


WIRING OF SIMPLE DOUBLE TRACK STATION



WIRING OF MAIN LINE STATION

FIG. 27



WIRING OF ADJACENT STATIONS
COMMON WIRE HATCHED

FIG. 28

SIGNALLING WITH TWO-RAIL

It is commonly supposed that electric signalling with two-rail is impossible. Whether it is or not, however, depends upon what form of signalling is intended. I myself have not yet seen a satisfactory two-rail track-circuiting idea, though I am assured that one or two such schemes do exist. The main difficulty, of course, is that the wheels, in two-rail, do not carry the current across the tracks, as they do in real practice. Various methods of employing treadles and relays have been experimented with to this end, but tend to give trouble. And this difficulty would also appear to rule out most of the block system also.

I have, however, yet to be convinced myself that there is any real advantage in having the trains to operate their own signals, and thus to render more or less automatic the whole signalling system on a layout. It is just as correct a procedure to operate the signals from the usual controls by the trackside, whether manually or by switches on a switchboard. I have devised a system of my own of operating signals electrically with the agency of the various types of switches and controls I have so far described, and not many of them. This system I propose to describe in detail.

One of the most difficult problems in such signalling (two-rail) is that presented by single-line working where the trains operate in both directions. The scheme in Figs. 29 and 30 seems to me to solve this problem. The equipment required is as follows:

Electric coil signals of the common commercial type.
One controller, as described, with signal attachments.
A common solenoid point-operator.
Two push-button switches to operate the point mechanism.
One six-contact slide switch as already described.

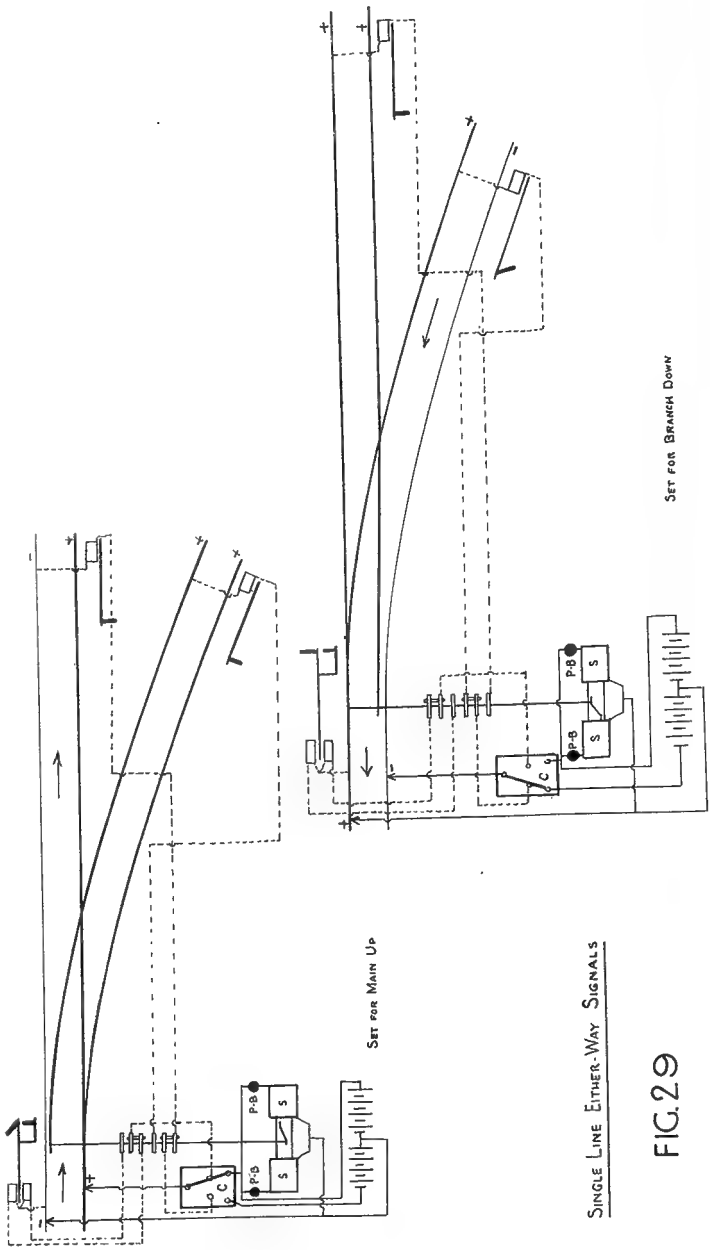
For this formation, there are two bracket signals and two single semaphores. They are located as shown, the single-arm signals being perhaps slightly further out on the tracks. In the drawings, P-B means push-button, SS means solenoid point-operator, and C means controller. In the first plan, the tracks and signals are set for the main " up " and they have been set—points, current, signals and all—simply by pressing the right-hand button. This operates the coil, which sets the points, which directs the track-current, and also this moves the contacts of the slide switch and operates the signals, putting some " on " and some " off." It always puts the right ones on and the right ones off according to the lie of the points, and according to the position of the lever of the controller, whether forward or reverse. For clearness, the signal wires are all shown as hatched. Tracks positive are heavy, negative light.

In the first plan, therefore, the current of the straight is permissive, and for the branch prohibitive. The signals are similar. In the second drawing, roads and signals are set for the " down " branch. That is, the controller has been reversed for the opposite direction and the other push-button has been pressed. The points have moved, the bracket signal has been deprived of current and has gone to " on " and one of the single-arm signals, the correct one, has gone to " off." In the top drawing of Fig. 30, roads are set for the " down " straight, the controller being untouched, the points shifted. In the fourth drawing, tracks are set for the " up " branch, the reverser has again been moved over, the points operated by the push-button, and the correct signals have gone to " on " and " off."

This form of control, which I submit is anything other than complicated, can be applied, with a little thought, to any formation whatever. For the double junction the appliances are just the same, with the addition of the extra controller for the extra track. The wiring is the same. The track formation includes the switch-diamond as earlier described. Fig. 31 shows the roads normal for the double branch; Fig. 32 shows what happens when the roads are set for the normal straight and (in the lower diagram) both roads for the straight, the " down " being reversed. It will be seen that when one road is reversed, the attached signal, which is only for a forward movement, it left " on."

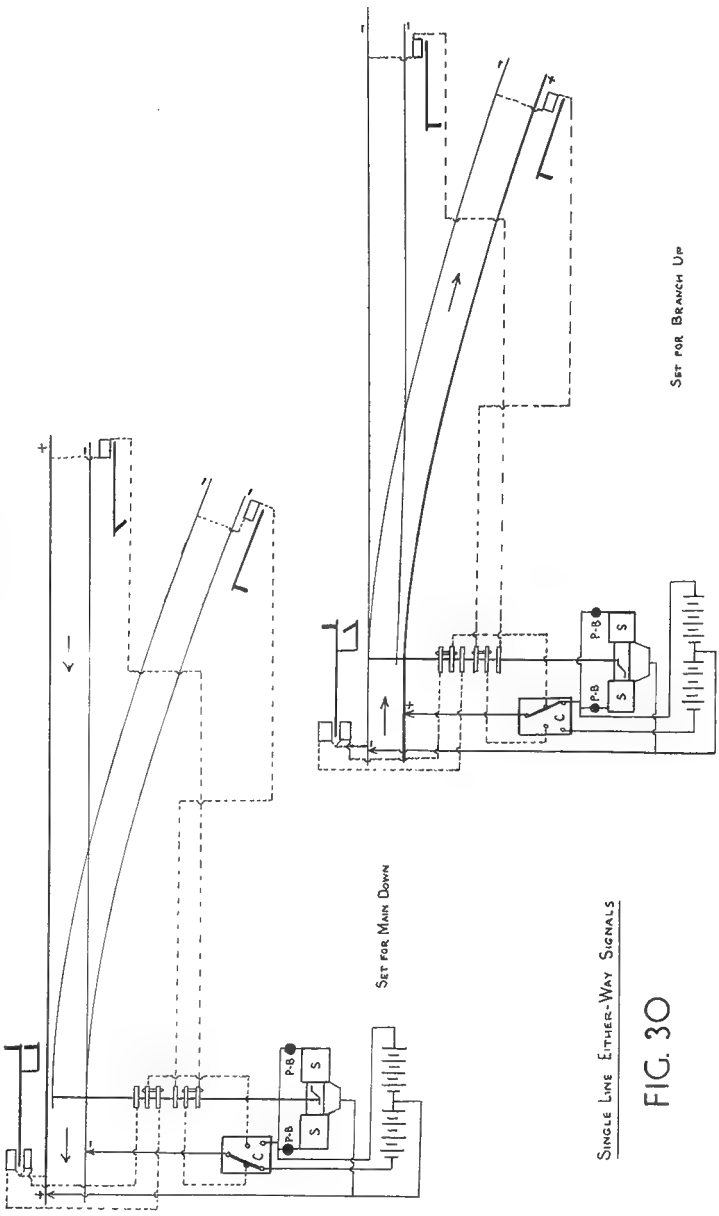
As a final example, I have chosen one of the most difficult of all formations—the double through road, and have again included all the point-rodding. This layout involves two of the slide-switches, since it required one, as we have seen, for the ordinary operation of the points and their insulation. The extra one is for the signals. It will be found, if all the other possible road-settings for this formation are tested out on paper, that the system will perfectly apply. In this drawing (Fig. 33) the roads are set for the normal straight. It must be borne in mind, as before, that with this formation, for any reverse over the crossing, both roads must be reversed.

Apart from the simple tell-tale lamp already described, for the purpose of indicating a section of crossed polarity to an approaching train, there are several other simple schemes of wiring-up dwarf signals in goods and passenger yards, or at main line sidings. One of these is illustrated in the two lower diagrams in Fig. 31. This two-light arrangement guards against trains coming into a dead section of track, alternative green or red lights being given according to the setting of the points. The bulbs used should be of the same voltage as the main power of the layout. Of course, if the main line current is shut off at the controller, no light will be given. But this is immaterial, since there will then be no danger.



SINGLE LINE EITHER-WAY SIGNALS

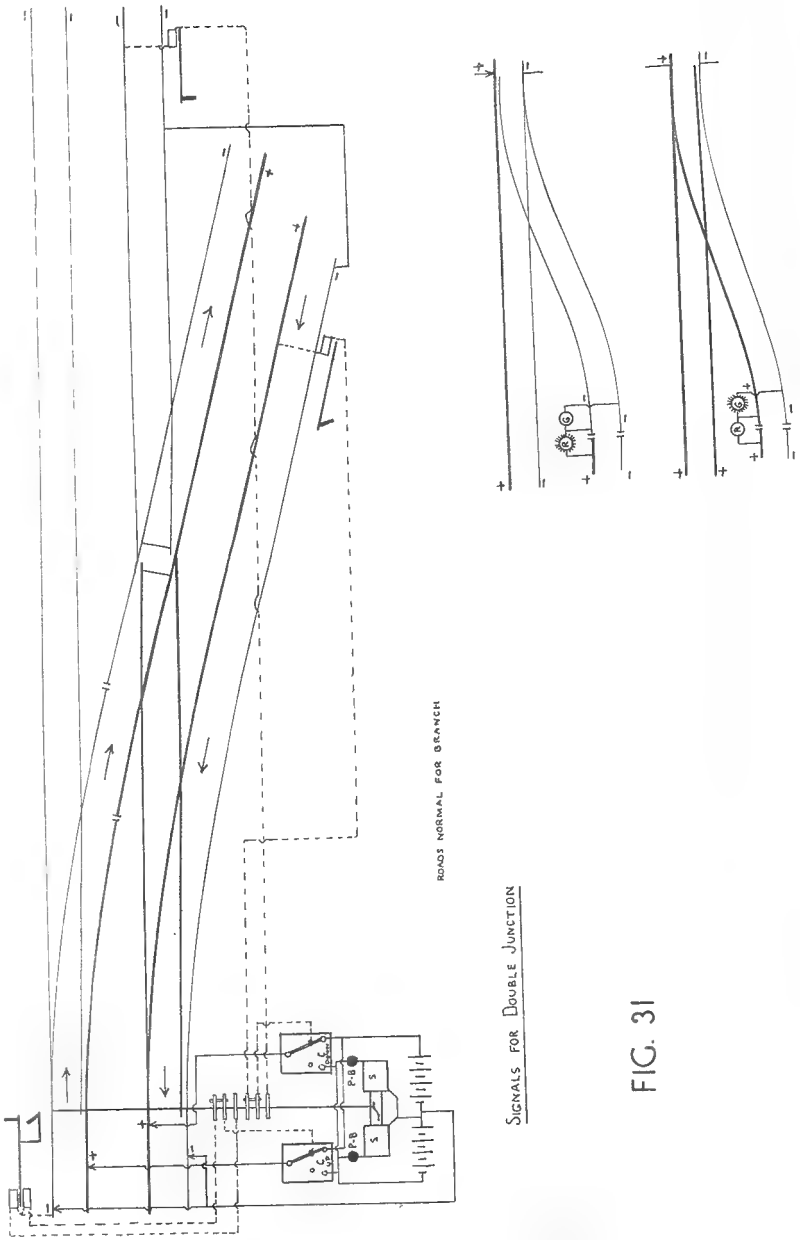
FIG. 29



SINGLE LINE EITHER-WAY SIGNALS

FIG. 30

TWO-RAIL CONTROL



SIGNALS FOR DOUBLE JUNCTION

FIG. 31

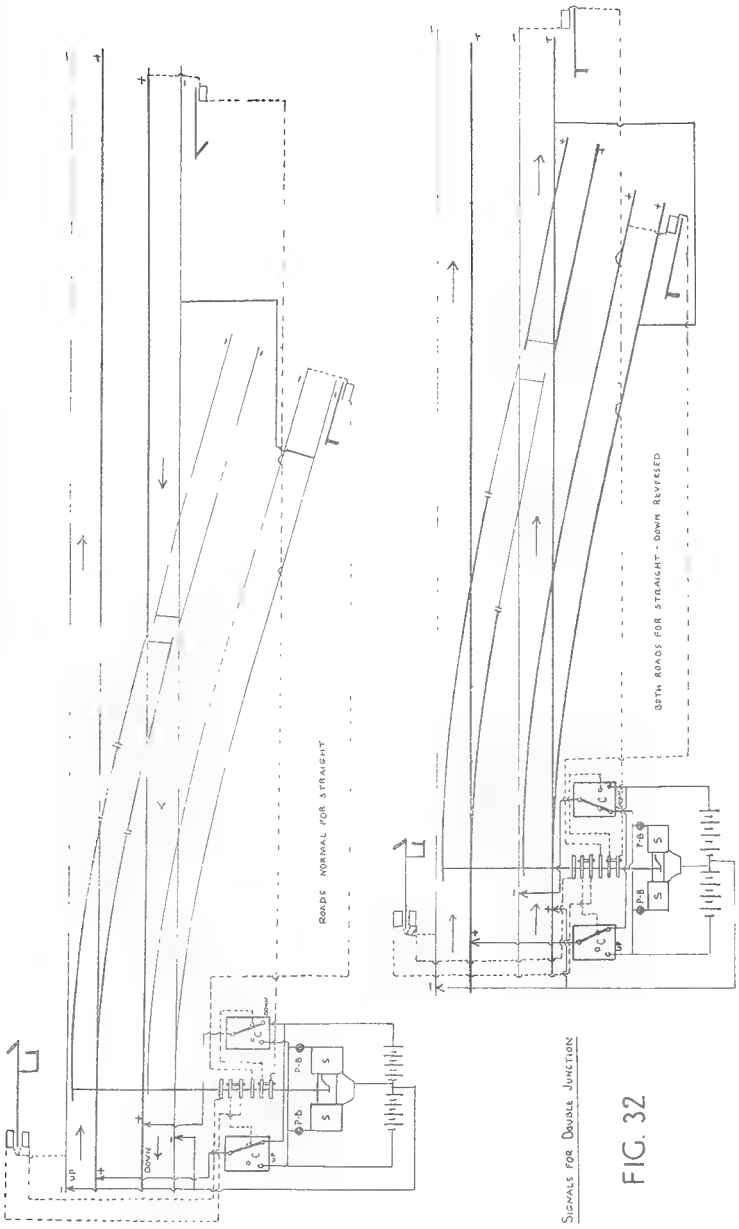


FIG. 32

SIGNALS FOR DOUBLE JUNCTION

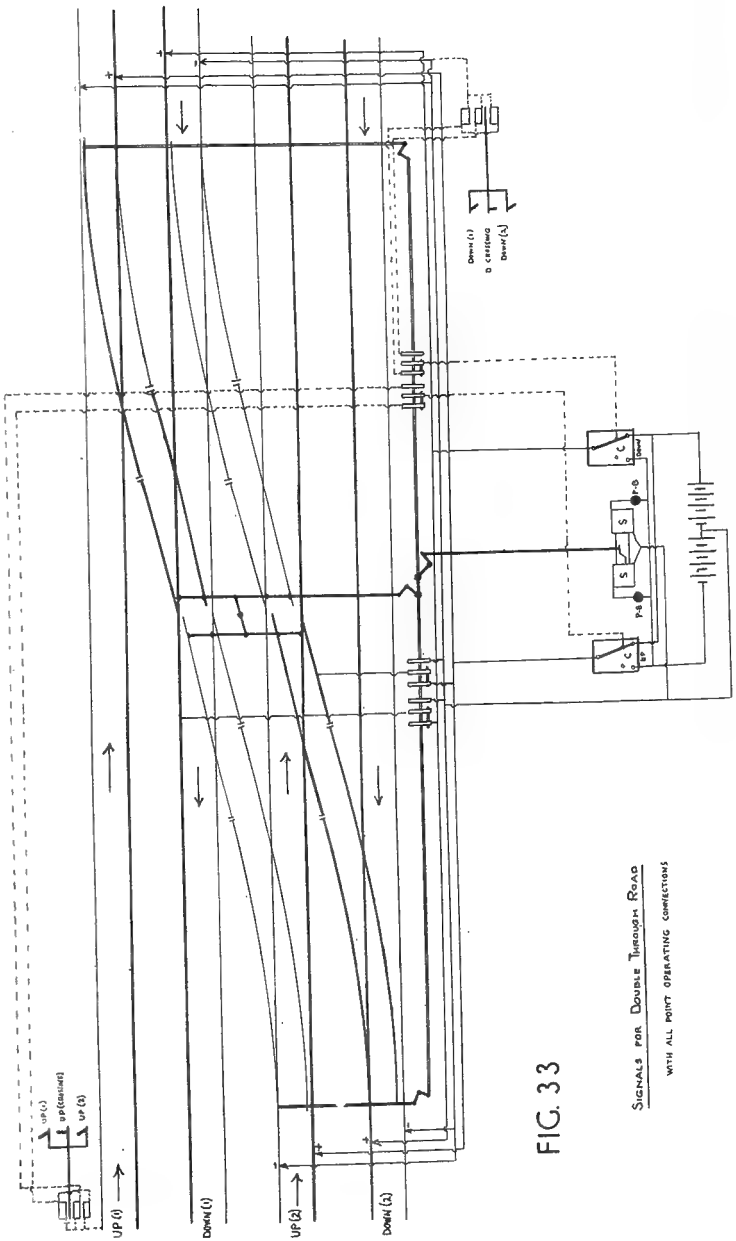
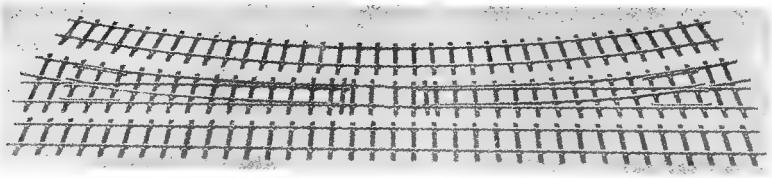
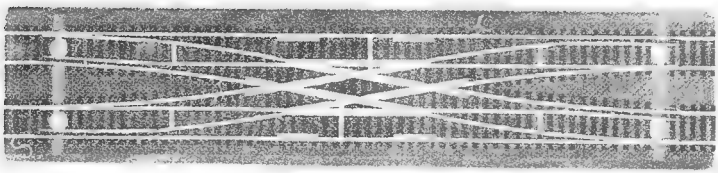


FIG. 33

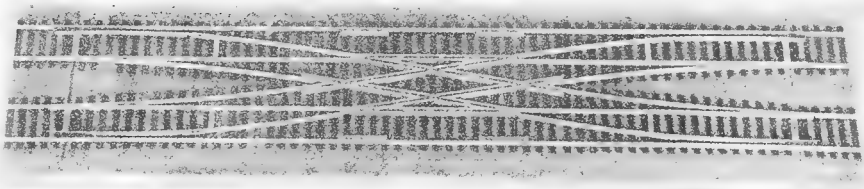
SIGNALS FOR DOUBLE THROUGH ROAD
WITH ALL POINT OPERATING CONNECTIONS



Mellor's Insulated Track for 00 Gauge

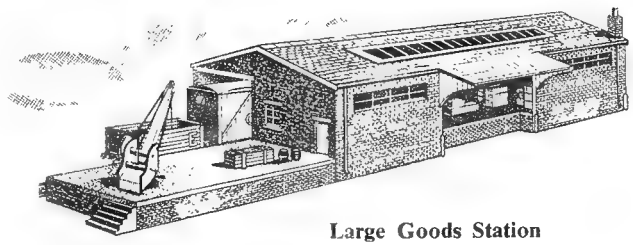


Two-rail Scissors Crossing by Windsor Models, U.S.A. (Rigid diamond type)



Scissors Crossing for Three-rail (Windsor Model)

Lineside Kits



Large Goods Station

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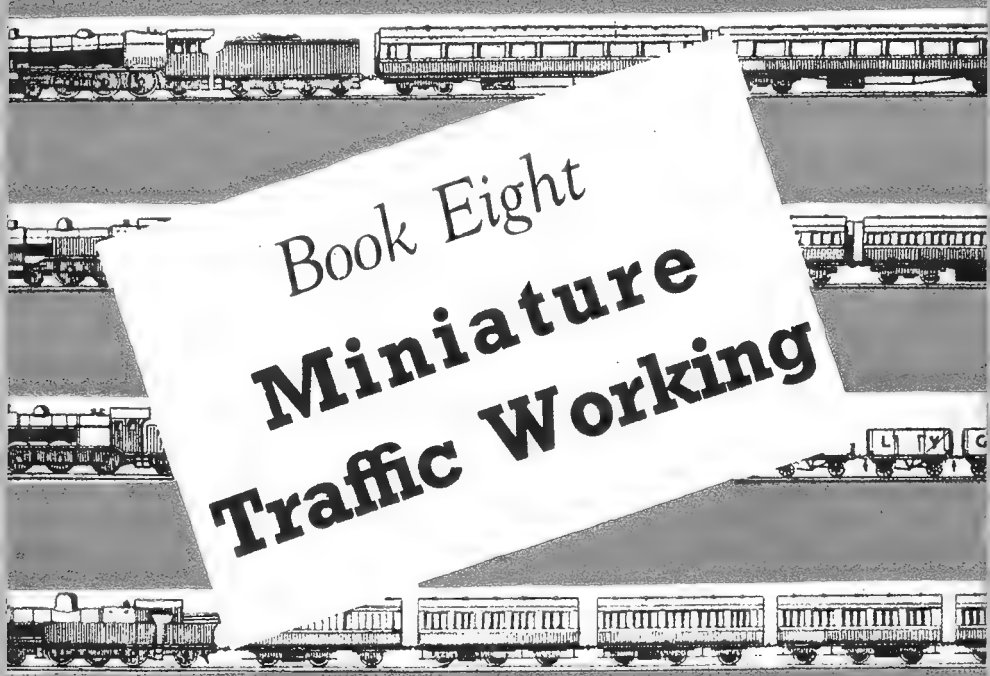

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BOOK EIGHT

MINIATURE TRAFFIC WORKING

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MINIATURE TRAFFIC WORKING

THERE is a prevalent idea that when the work of constructing a miniature railway layout is completed and the trains are at last running satisfactorily the interest is exhausted. Uninitiated visitors, on viewing such a layout, will often ask : What use is it when once it is done ? And indeed, the insinuation behind this question is in some instances warranted, for there are many enthusiasts whose sole concern seems to be with the work of building and designing, and who have no idea of the fascination of using a layout when it is ready for use.

It must be frankly admitted, of course, that the actual measure of enjoyment attaching to operation will be conditioned by the size and possibilities of the layout. I have, I understand, been sternly challenged by certain of my readers on the score of offering layout designs that are far too ambitious for the average worker in these days of restrictions and frustrations. People write me as if I were not aware of the small proportions of many modern houses and of the difficulty of obtaining space for a fair-sized scheme. I am only too familiar with these conditions and have every sympathy with the keen person who is so restricted ; but the truth nevertheless remains that a layout designed to fit within the very minimum of essential space will not retain its running interest for any appreciable time ; and there is nothing so bad for the craft as a whole than for the starter to become almost an immediate deserter on these grounds.

Granted, however, a reasonable space in which to lay down the tracks and facilities, let no one imagine that construction is the most attractive factor. The truth is that a layout, like its prototype, is designed for service, and such service in the modelling sphere is all the more fascinating because it has been only so slightly exploited. It is merely a small proportion of craftsmen who win so far through, again, as to be faced with the actual opportunity of operating the layout on correctly organised lines.

Operation itself has many aspects, depending in large measure on how many operators there are, on the size of the layout and on the question of whether the traffic is involved or simple, or is solely confined to freight, or consists of freight and passenger running combined. It does not belong to our present subject to discuss the possibilities of automatic or of cab-control, or the question as to how the signals and points shall be worked. We are interested at this stage simply in the general conditions of traffic operation from the modelling standpoint, and in discovering how far the real rules of railway procedure can be simulated in the miniature movements of such a system.

GOOD AND BAD OPERATION

It goes without saying that there are two broad ways of carrying out such operation. One of these is simply the promiscuous running of trains, anywhere and anyhow. Too many operators there are who are strangely content to link up a train and attach an engine of any kind and run it around the tracks at a speed of about 180 miles an hour without the faintest regard for traffic rules, the formation of the train, the type of locomotive employed or the work involved *en route*. This matter of fantastic speed is really an important one, for there are few operators who will believe that their operating speed is excessive, or who are content with the comparative slow movement of express trains when they are correctly worked. An enormous amount of wear and tear, of burnt-out commutators and of persistent derailments—especially in shunting—is due to this strange foible. The majority would scarcely credit the statement that for a train to run from end to end on a 500-ft. 00-Gauge main line at an average speed of 30 miles per hour (scale)—this being equivalent to a fairly fast stopping train attaining often a speed of about 60 miles per hour—should occupy something like 13 minutes. Let the operator begin with that standard and work accordingly on his goods traffic and shunting, and he will be astonished at the slow speed of his train. It is obviously essential that for such operation all the mechanisms in use must be capable of a crawling movement, especially when operating within yards and in starting up trains from a standstill. It must be remembered in all fairness to one's layout that any actual train would derail if operated at 200 miles per hour; and when the unavoidably exaggerated spacings involved in model track-laying and wheel design are taken into consideration, the injustice of straining over fast speed becomes all the more apparent. The worker is therefore advised to take some time over experimenting in this question of working speed at the very outset, so that he may get the " look " of trains moving about at the speed required by their particular form of service at the time. A good guide is to remember that the average speed of British freight trains is only 8½ miles per hour, this figure, of course, embracing all manner of freight running, from shunting to express operation.

It may be useful to offer some sort of guide to the beginner as to the actual scale speed of model trains. While it is scarcely possible to claim literal infallibility for these criteria, they will be found reasonably accurate. The method is to take one's stance at some stationary object such as a telegraph pole, with a watch in one's hand, and to count the seconds as

a train passes the object. Choose a period of $2\frac{1}{2}$ seconds, and the following table will give the desired results :—

Four wagons indicate	25 m.p.h.
Five wagons indicate	30 m.p.h.
Six wagons indicate	40 m.p.h.
Eight wagons indicate	50 m.p.h.
Ten wagons indicate	60 m.p.h.

For the testing of passenger trains make the second-period $7\frac{1}{2}$.

Precisely as in real practice there must be strict observation of running rules, so in the miniature realm of operation such rules must be made and rigidly observed. To begin with, all equipment must always be in sound running order. Unless this is so, there will inevitably be many slight delays which, though not very apparent to the operator, would, in real trainworking, enormously dislocate the timetable. Stiffly-running wheels, sluggish mechanisms, bad couplings and so-forth must be a matter of constant vigilance. If you are going to do the thing right, you may as well start right.

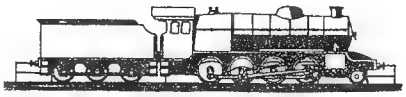
There must also be strict observation of every kind of movement, such as starting, slowing down, stopping, crawling. climbing, downhill running, coupling and uncoupling and spotting wagons. Slow running is really something in itself worth practising, especially on gradients. In starting up a train of any kind it is a good idea to simulate the action of an actual driver by gently backing up the train to slacken up the couplings, especially if the train is lengthy, so that when the train actually does start it only has to draw one vehicle at a time. Even though in miniature this action is so minute as to be negligible, the procedure itself is correct. With smooth stopping, also, a great deal of experiment is necessary. It doesn't matter what form of gearing you use, there is no reason whatever for a sudden jerk and the sliding of locked wheels whenever a train comes to a standstill. The correct use of proper controllers will immediately serve to eliminate this fault. Such slow stopping becomes habitual with repeated practice. Particularly essential is the meticulous adjustment of couplers so that they work, as they will if so adjusted, without any failure or hitch.

While speaking of such practice, it might be well to dwell upon the need of *training* in the operation of traffic. It is decidedly not a task that anyone can carry out in a haphazard manner, and that is the main reason why operation is fascinating. It requires the same measure of patience, practice and trickiness of hand as the work of construction requires. Yet many an owner who has endless resources of patience in the work of track-laying, will attempt to operate his system like a bull in a china-shop! Let him rather realise that now that the layout is finished, he has reached the moment when the real consummation of his effort is to be achieved, and has created the apparatus for which his training as an operator is demanded, and without which he could not thus qualify.

There are both good running and bad running as open possibilities whether the system is operated by one man or several. In the instance of

a multiplicity of operators, of course, it may be possible to run numerous trains at one time ; but where the railway is under the hand of one person only it will rarely be found feasible to run more than one or two trains simultaneously—unless some form of automatic control is employed. Nor is it really desirable to run a number of units at once. To operate one train, especially in the presence of spectators, while at the same time manoeuvring make-ups and marshallings in a yard, is a nerve-trying task to the majority. It should be borne in mind that even a skilled signalman in an actual cabin does not *operate* trains ; he merely controls their movements over a given section under his observation. In the instance of a club, where there are numerous men in control, something of the same order may be possible, and an almost unlimited number of trains might thus be run at one time, but not otherwise. This is the reason why many visitors stand aghast, when they ask : How many trains can be run at once ? and receive the curt but honest reply : One ; sometimes two.

For the comfort of the beginner in operation, it may be said that the work of operating is something that grows upon you with practice. At the outset it may appear monotonous, uninteresting and wearisome, simply because it forms such a contrast to constructive work and designing. But whether it is so or not, this is really the whole of railway modelling brought to a culmination, and it is a pity that so few appear to get so far as to be possessed by its charms.



TRAFFIC ASPECTS OF LAYOUT

It will be part of our task in this section to discuss the whole question of track-formation and layout in relation to traffic-running. An actual railway system, be it remembered, is constructed in order to convey traffic from one place to another. Any miniature of such an organisation ought surely therefore to do the same thing, or to carry out such movements as to appear to be doing it. And it may be emphasised that actuality is in this connection preferable to pretence. Now, in the first diagram in Fig. 1 we have a mere oval of track with a single station. On this layout there are no traffic facilities whatever beyond the existence of this one station, marked A. It is, of course, possible to imagine a great deal, and to load trains and marshal them at the one station, bringing them back again under the pretence that they have been somewhere. But the most optimistic will agree that there is not much edification in that procedure. But if a second station can be introduced, as in the next diagram, the two terminals being marked A and B, an entirely different situation is presented. Traffic can now be actually despatched and received, to say the least, this improvement attaching both to goods and passenger items. In the third diagram, however, we have vastly increased the scope and interest of the layout from a traffic standpoint by introducing a third station (H) for passing traffic and a large number of industrial centres (in many ways preferable to stations) marked C, D, E, F, G, K, J, seven in number. The advantages of these factories are that they may be of any size and can be accommodated in any layout of even the most modest proportions, and they provide for freight traffic just as large a scope as a big freight yard. In the fourth diagram we have a somewhat larger scheme in which at J there has been introduced a divisional locomotive centre, which will provide for engines, goods wagons and passenger trains alike an added facility giving an enormous improvement in traffic working. At this centre are the sheds of the company for the stabling of locomotives, and here the engine power of all trains—or at all events of main line ones—is changed as required. A large number of timed locomotive movements are possible at, to and from this centre. These conditions may be obvious enough to the experienced, but to the beginner they may not have occurred.

Much importance, again, attaches to the question of whether a station is a through station or a terminus. The first plan in Fig. 2 shows a through type for double track service, while in the second plan we have a terminus. The important features of these designs are the length of the platforms, the provision of a goods arrival track with a run-around for locomotives

A
ONE STATION - NO TRAFFIC CENTRES
A
B
POSSIBILITIES WITH TWO STATIONS
A
TERMINUS
F
H
TUNNEL
J
B
TERMINUS
G
E
D
C
K
MORE CENTRES INCREASE INTEREST
D
A
TERMINUS
C
TERMINUS
E
J
DIVISIONAL CENTRE
B
TERMINUS
H
G
F
ARRANGEMENTS WITH DIVISIONAL LOCO CENTRE

FIG 1

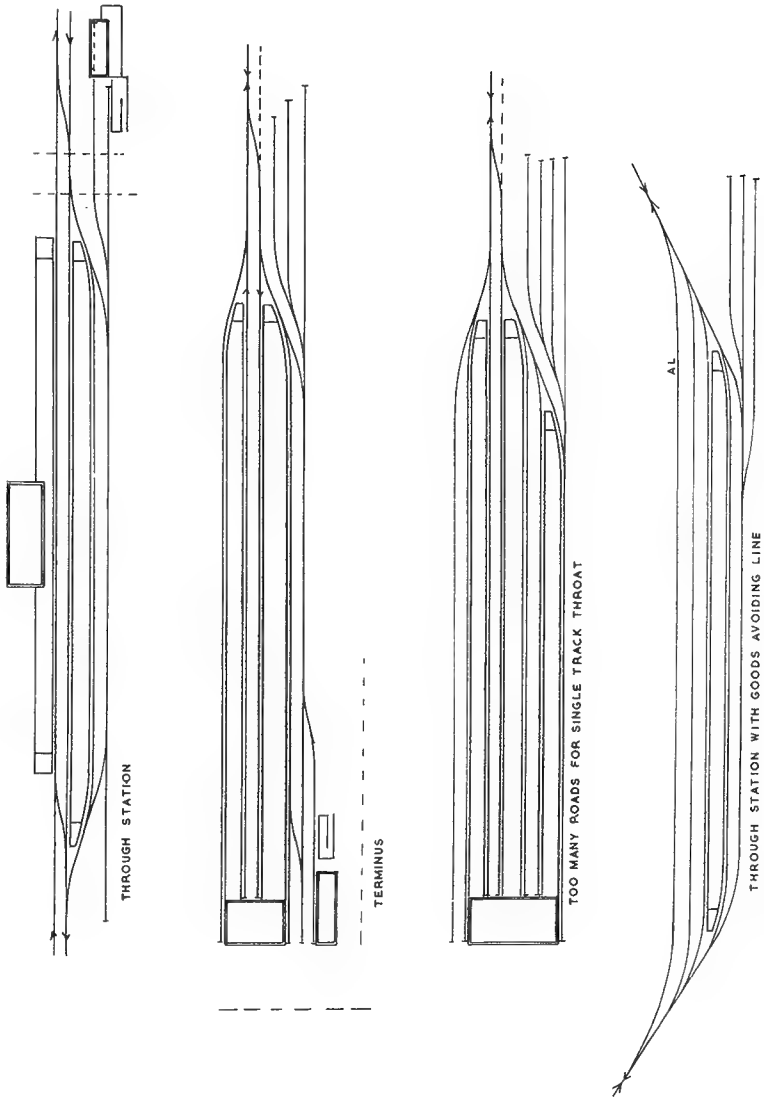


FIG. 2

TRAFFIC ASPECTS OF LAYOUT

on arriving trains, adequate road access for passenger and goods traffic, trackage provision for the handling of passenger trains and their engines arriving and departing, and the usual structures common to such centres, such as goods sheds and cattle pens.

Either of these plans would suit single or double-track main line; but where single-track is the vogue it may be well to notice that there is a limit —more or less flexible it is true—to the track-dimensions of a yard where only single-track is employed. I have tried to show this in the third plan. Here, the station is fairly large, and the goods traffic facilities somewhat extensive, so that the main line movements might become complicated enough to cause delays and obstructions on the single main line. There are, I know, instances of much larger single-track stations in actual practice, but on a model system they are to be deprecated. Very often, with single-track, a great deal of obstruction is avoided by providing a passing or avoiding-line for goods trains, as indicated in the fourth plan. If you want to have good, representative operation, these matters should be observed in planning.

The work of designing railway junctions from the traffic standpoint is important, since many junctions combine both the through and the terminus function. In Fig. 3 we have four types of junction station—the first having a double main line with a single-line junction on the down main. In these designs I have included various slip points for convenience, but they are optional, and may be substituted at will by extended cross-overs. In the first design there will be a facing crossover to enable up trains from the west to enter the branch, as well as a facing crossover on the west end of the up line to permit eastbound trains to enter the goods yard. This latter is, however, optional, and may be substituted by a trailing crossover on the east end for eastbound goods trains to back in. In the second design, the junction being off the up-main, the facing point is avoided for the double-track. The standard island type of junction is next shown and provides for double-track throughout. But a junction station need not take this form; it may be designed as a simple and regular station of the " straight " type as shown in the fourth diagram, the branch lines either coming in as shown or, indeed, entering on the double main line at one or at both ends.

In planning a junction, endeavour to keep down the number of facing-points as far as at all possible, in accordance with real procedure. Let the goods sidings and arrival track be as commodious as the double-route traffic requires and, as a general rule, provide tracks for the storing of coaches. Further useful information on track formation in this connection is given in Fig. 4, the upper diagram giving the standard track nomenclature for the benefit of the beginner. Notice that the platform tracks at the passenger station are so arranged as to permit the one side of the platform to accommodate two trains coming in either direction. The tracks marked " independent " are actually a lead from which the sidings are taken, and on which shunting movements can be carried out, or on which arriving and departing goods trains can wait. The reception sidings are

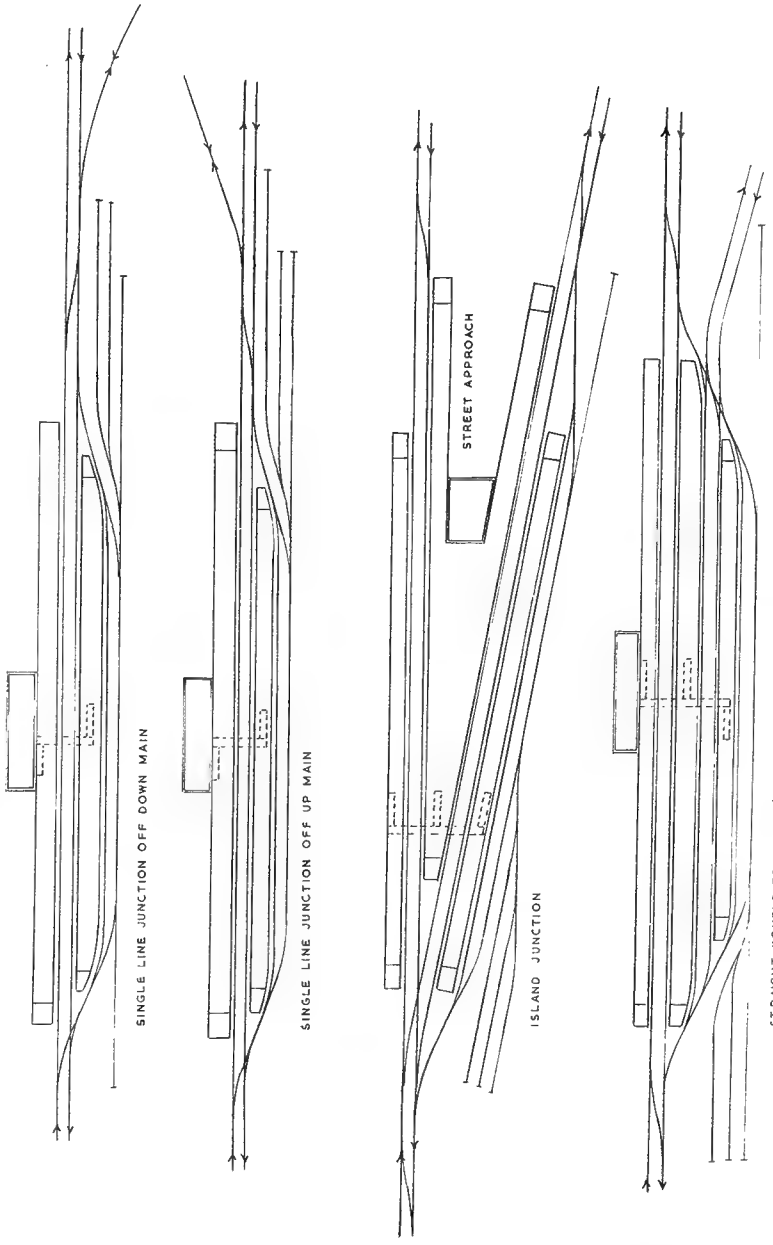

SINGLE LINE JUNCTION OFF DOWN MAIN
SINGLE LINE JUNCTION OFF UP MAIN
STREET APPROACH
ISLAND JUNCTION
STRAIGHT DOUBLE TRACK TYPE

FIG. 3 TRAFFIC ASPECTS OF LAYOUT

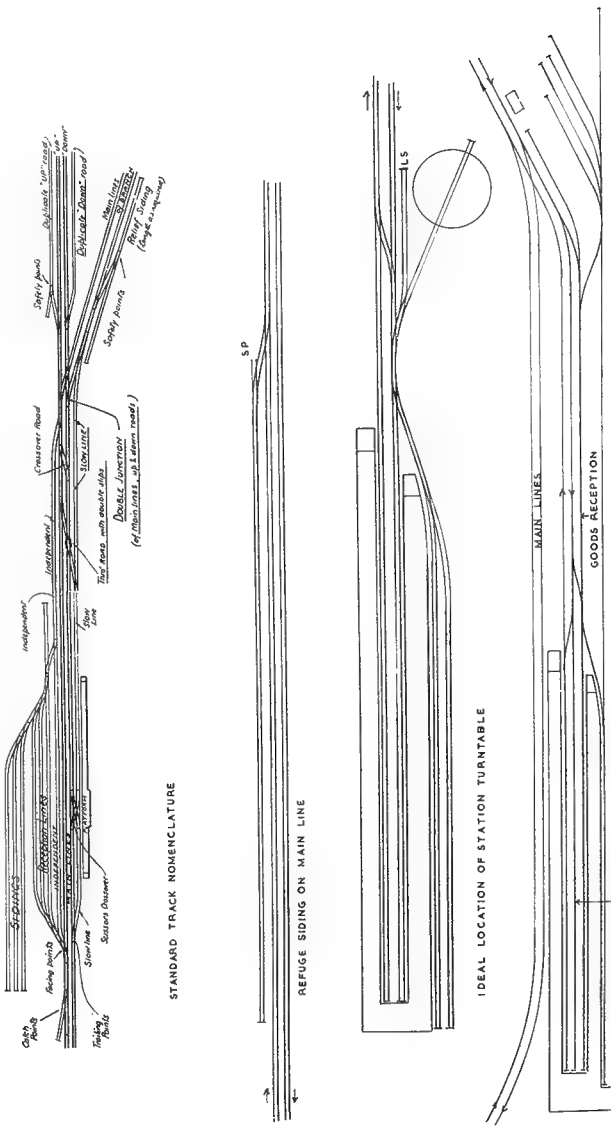

STANDARD TRACK NOMENCLATURE
REFUGE SIDING ON MAIN LINE
IDEAL LOCATION OF STATION TURNTABLE
TRAFFIC ASPECTS OF LAYOUT
SP
LS
MAIN LINES
GOODS RECEPTION
COACHES
CENTRE TRACK AT PLATFORM

FIG. 4

for arrival trains and are provided with a shunting neck, which enables the sidings to be reached as the trains are drawn out wagon by wagon, or in batches of wagons as the case may be. Safety-points are provided wherever the nearest track of a siding leads on to the main line. The main line has duplicate roads for fast and slow trains and the branch has a relief siding. This relief siding will be connected to the main line at the end not shown, and differs from the refuge siding which is shown in the second plan. This refuge siding is located on the up-main, and the procedure is for trains to back in, being slow, to await the passing of an overtaking fast train on the main line. It also has safety-points.

From the aspect of traffic working the location of turntables is of great moment. There can of course be no fixed rule, but the ideal position is given in the third diagram, where the table is situated immediately adjoining the main arrival track, so that engines can enter and be turned with the minimum of movements. By the side of it there is a short locomotive spur, on which a shunting engine or main-line locomotive can wait. A good station from the traffic standpoint is given in plan four, where there is a centre track between the up and down platform tracks for the storage of coaches. The plan also has the advantage of occupying one side of the layout while the main lines pass it on the inside.

Hump marshalling yards have been described in an earlier handbook ; but it may be a good thing to examine these in order to dwell upon their operational features. Two are designed in Fig. 5 and have been arranged to occupy as little space as possible. The first, suitable for a corner, like the second, for the straight, has all the gradients clearly indicated. Since the yards are provided only on one side of the main lines, they require a turntable in each instance, so that both up and down trains going in either direction after sorting, can be dealt with. If the yards were duplicated on each side of the main, then no turntables would be required. Each yard is provided with a run-around track for main-line engines, so that the engine of a train arriving, let us say, from the east (on the lower plan) could detach from its train, take the crossover on to the main, reverse back to the eastern crossover and by again reversing enter the track to the exit of the yard on the west. In the plans I have given all the essential tracks and nothing more, the design being for oo-Gauge.

Flying and burrowing junctions will almost inevitably occur where there is more than one level on a layout, and in Fig. 6 an attempt has been made to give a visual presentation of the maximum steepness of the gradients involved. In the upper drawing the junction is of the normal type, where the crossing track rises and the remaining tracks are on the level. Now, it may be that the branch roads, when they have left the main line and one has crossed over it, do not require to descend again to the low level—the branch may, in other words be leading permanently to a higher level. In this instance, both of the branch tracks must turn out together and both must climb on either side of the main. But if, after the crossing has been accomplished, a descent is to be made to low level again the non-crossing track does not require to rise, and does not need to

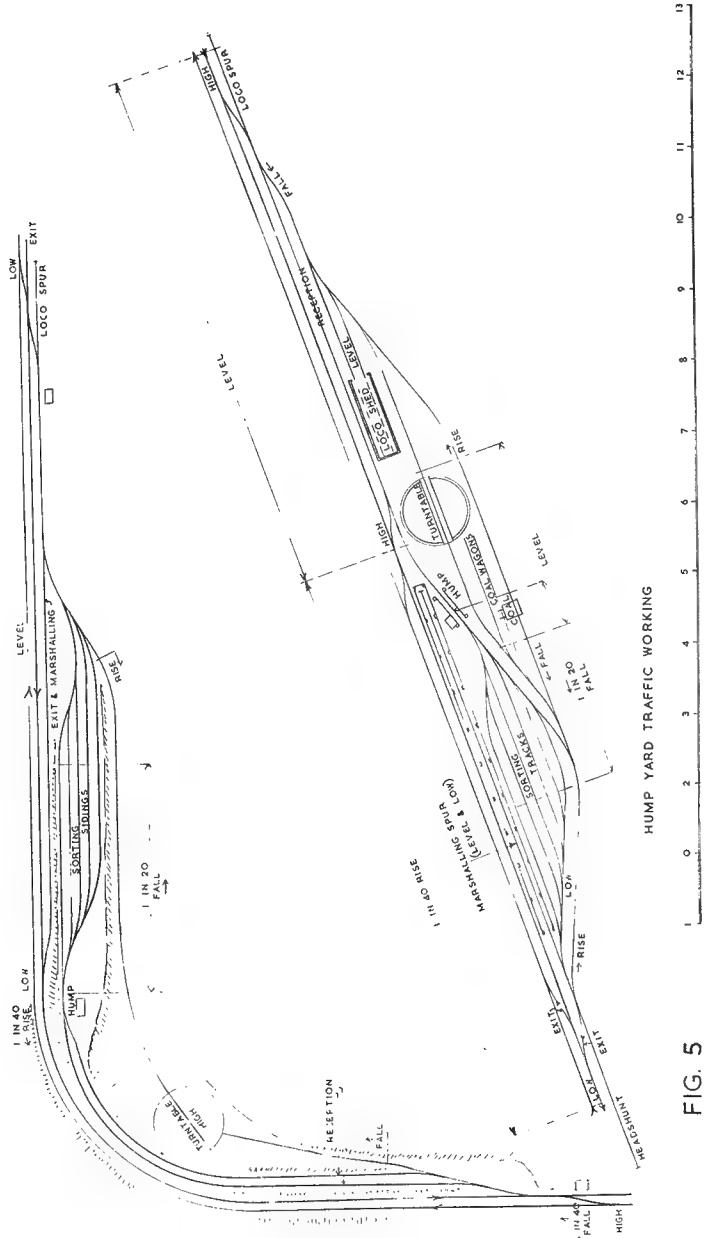
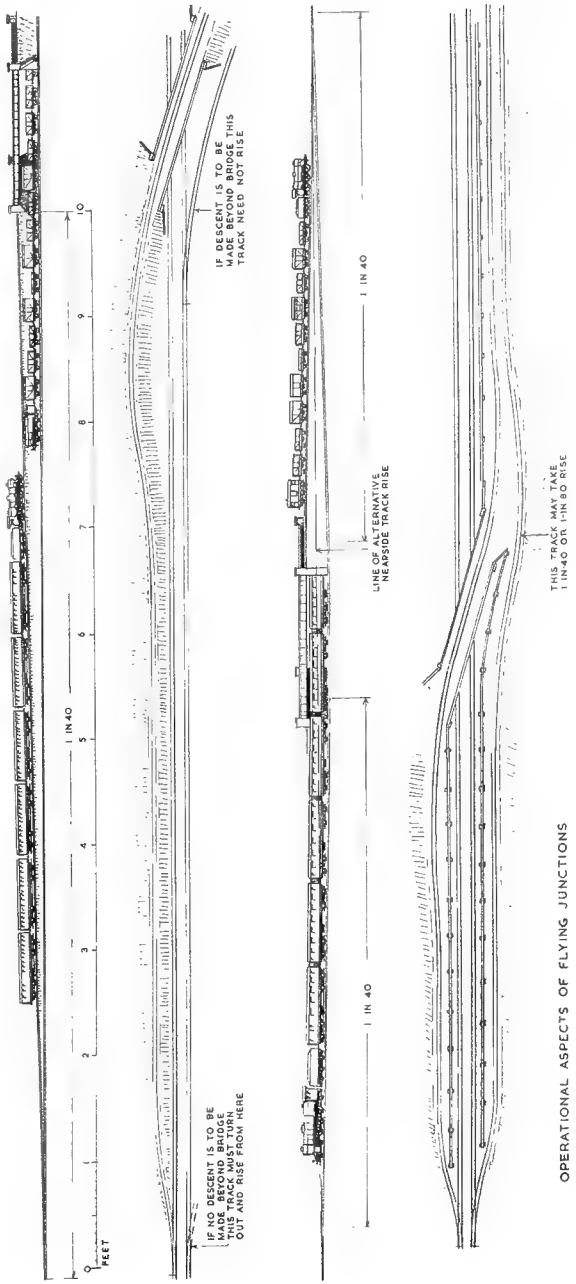

LOW
EXIT
LOCO SPUR
LEVEL
EXIT & MARSHALLING
SIDINGS
SORTING
RISE
1 IN 40
RISE
LOW
HUMP
1 IN 20
FALL
HIGH
LOCO SPUR
FALL
RECEPTION
LEVEL
LOCO SHED
HIGH
TUNNEL
ROAD
OVER RAIL
RISE
HUMP
COAL
LEVEL
1 IN 20
FALL
SORTING TRACKS
1 IN 80 RISE
MARSHALLING YARD & LOCO SPUR (LOW)
LOW
RISE
EXIT
EXIT
LOW
REFRESHMENT
1 IN 40
FALL
HIGH
HEIGHT
FALL
HUMP YARD TRAFFIC WORKING
FEET

FIG. 5



OPERATIONAL ASPECTS OF FLYING JUNCTIONS

FIG. 6

leave the main at the same place as the rising track.

Turning to the lower drawing, we have the arrangement where both the main lines and the branch lines are graded, and whereby the junction can be achieved in one-half the lineal space. Here, as will be seen, the same gradient of 1 in 40 has been maintained, and it is assumed that the main and branch lines retain the same level as each other after the junction is passed. The requirement here is that both branch lines leave the main at a point opposite one another, but it is worth noting that one of the branch tracks—that which does not cross over the main—need not have the ruling gradient of 1 in 40 but can be arranged, for more convenient working, at a gradient of 1 in 80.

The drawings will give an idea of the degree of steepness involved in such a junction at 1 in 40, which is fully workable with quite heavy trains ; but it will also show that the grade is rather severe, and could with much advantage be spread over a longer distance.

There are numerous methods of carrying out the track arrangements at these junctions, and these have been expounded in the earlier section.

We come now to the question of dealing with locomotives and trains at the various stations, and to the subject of providing the means of handling their business. The terminus planned in Fig. 7 is, to my mind, of a size competent to deal with the traffic on a miniature layout of any size, and I think it unwise to aspire after anything more ambitious. The street entrance leads off into the background, and the goods yard highway runs along the back of the station. A loading-gauge is located at the entrance (or exit) of the lead which gives upon the goods yard. The turntable is close by the main arrival track, and immediately adjoins the locomotive yard, with its sheds and coaling facilities. In the goods yard the derrick is situated at the widest part of the roadway immediately by the shed. There are three passenger platforms and a coach storage track, while there is also a bay for carriages and milk traffic, the latter having a special road entrance. The platforms are of adequate length, but no longer than necessary.

Operation should be kept constantly in mind when designing all manner of trackage expedients. Waiting or passing loops on the main line are an important thing. By installing these—whether on double or single track—it is of course possible for one fast train to pass another slow train ; and by extending the principle a little, several trains, having set out on their journeys, can be stalled on such tracks until the passage of enough time to permit their imaginary journey. It is usual for tracks of this kind, as distinct from ordinary passing loops, to be arranged within a tunnel or behind a back-screen, or in some normally invisible section of the layout.

Loop tracks, over which a whole train can turn when it has arrived at its terminus, are scarcely known in Britain, though in America they are quite frequent in their incidence. And on a miniature system they are very often found advantageous, particularly on systems of the " out and home " variety. Avoiding lines also have an additional use in the model

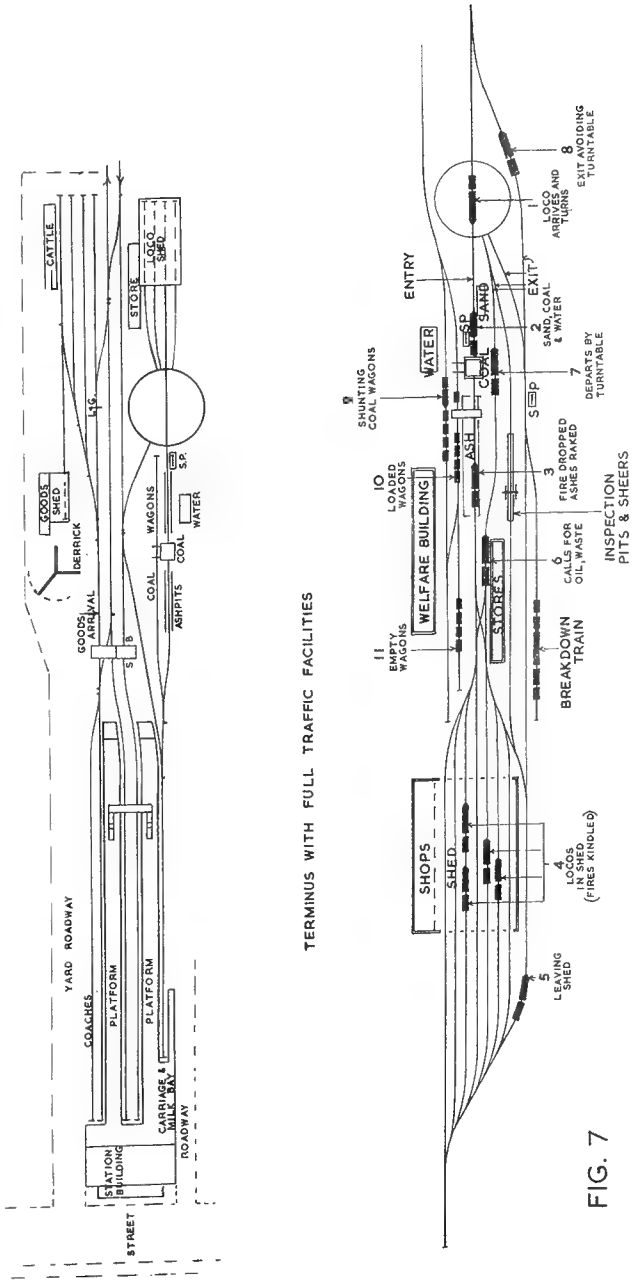
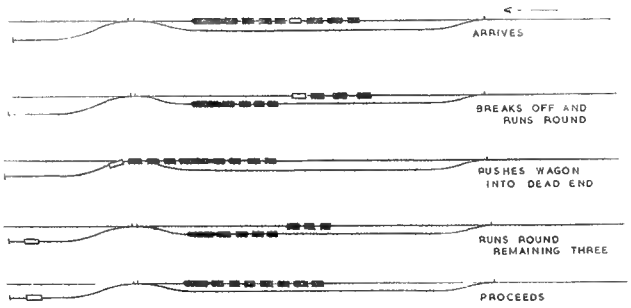
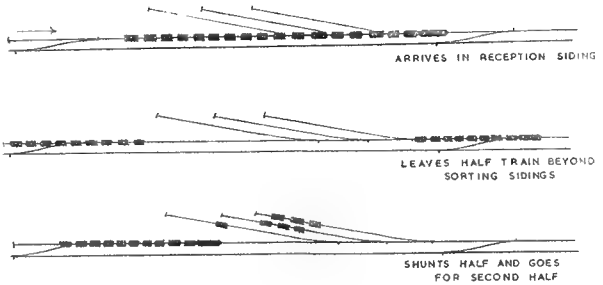

STREET
STATION BUILDING
ROADWAY
CARRIAGE & MILK BAY
PLATFORM
PLATFORM
COACHES
YARD ROADWAY
GOODS SHED
DERRICK
GOODS ARRIVAL
CATTLE
L15
B
S
COAL
ASHPITS
WAGONS
COAL
WATER
S.P.
STORE
LOCO SHED
TERMINUS WITH FULL TRAFFIC FACILITIES
LOCOMOTIVE SERVICING
SHOPS
SHED
4 LOCOS IN SHED (FIRES KINDLED)
5 LEAVING SHED
BREAKDOWN TRAIN
6 CALLS FOR OIL, WASTE
STORES
WELFARE BUILDING
11 EMPTY WAGONS
10 LOADED WAGONS
9 SHUNTING COAL WAGONS
ASH
3 FIRE DROPPED ASHES RAKED
INSPECTION PITS & SHEERS
WATER
COAL
SAND
S
P
7 DEPARTS BY TURNTABLE
2 SAND, COAL & WATER
EXIT
ENTRY
1 LOCO ARRIVES AND TURNS
8 EXIT AVOIDING TURNTABLE

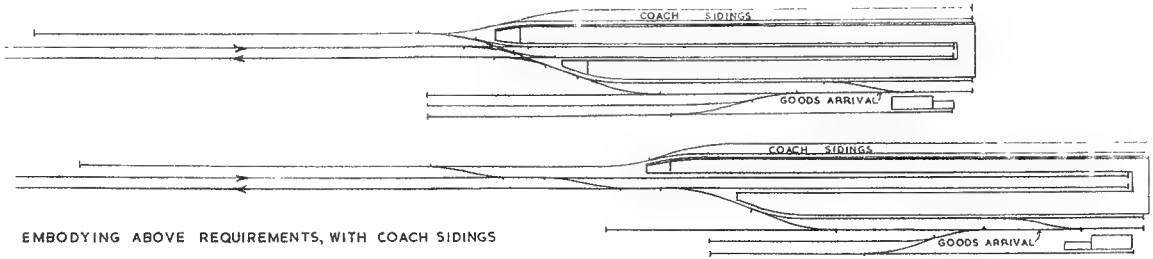
FIG. 7



VALUE OF A TWO-ENDED SIDING



HALVING A TRAIN FOR SHUNTING IN A RESTRICTED SPACE



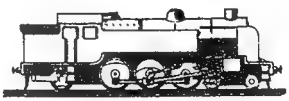
EMBODYING ABOVE REQUIREMENTS, WITH COACH SIDINGS

FIG. 8

sphere, being often installed in order that a train may make several loops of a track without touching the same station—the avoiding line in this instance being usually run behind the station, out of sight. Another indispensable scheme on a miniature system is that of the headshunt, along which goods or passenger trains can be drawn out at the head of their respective sidings. Their advantage lies in the fact that they enable a station layout to be included in a much shorter space, since the headshunt may be arranged to run out alongside the main line, the additional extra width required for this being negligible. The introduction of " bays " on a station for the accommodation of passenger trains enables the station to be conveniently used both as a through type and a terminus.

Coach storage tracks must be included at every station where there is terminus traffic and at all junction stations ; otherwise there will be congestion owing to the lack of facilities for clearing the tracks. These are shown in the lower diagram of Fig. 8, where the difference in length required for slip-points and for crossovers substituting them is also shown. It will be seen that empty coaches can be drawn out along the headshunt from any of the platform roads and pushed back into the storage sidings, and *vice versa*. There are, of course, other varied methods of laying down coach sidings, each one having its own advantage, and much depending upon local conditions.

When we turn to the subject of goods yards we find that there is much to be observed from the traffic standpoint. Most important, perhaps, is the matter of proving suitable and commodious reception sidings for incoming trains of freight, with ample arrangements for the detaching immediately of the arrived engine and the substitution of a shunter. From this reception siding, with its run-around track, there issues usually a shunting neck, or extension, along which the train, or part of it, can be drawn backwards and forwards while having access to the marshalling tracks. The idea is illustrated in Fig. 8 (upper right), though here the " neck " is purposely shown short, in order to indicate what happens when there is not sufficient room to draw the train, in its full length, backwards and forwards. It will be seen that the string of wagons is in this event broken in two and dealt with one-half, or less, at a time. A useful expedient in a goods yard is the two-ended siding—or, of course, there may be more than two such tracks. The procedure for cutting out a vehicle in the middle of a train is shown (Fig. 8 upper left).



LOCOMOTIVE ASSIGNMENT AND SERVICING

Every beginner is interested in the question of what type of locomotive to use in conjunction with the various types of passenger and freight traffic. While there are very definite rules in connection with this assignment of engines, these rules are extremely flexible, and are largely subject to the principles of economy and expediency at the time of running. Very often, again, a Pacific type engine will be employed for branch-line service, where road conditions are suitable, owing to the fact that Pacifics may be plentiful in the vicinity, though for freight traffic the orthodox procedure is to use engines of the 0-6-0, 0-8-0, 2-8-2, 2-8-0 wheel arrangements, whether tank or tender types. It is always the procedure, when practicable, to over-power rather than to under-power. Normally, of course, Pacifics, 4-6-0's and other bogie locomotives are used for passenger work. Very often a passenger type engine will be used for a goods train if it would otherwise be making a return journey to its depot without a train, in order to save fuel and to conserve power. Similarly, heavy power is often used on light trains for the same reason. Keeping in mind the reservation in general of passenger types and goods types for their proper work, the weight and speed of the train is usually the determinant. A train that is usually hauled by a Pacific may turn up one day with a Baltic because the Baltic was at the end of the line and had to be returned. Another day the same train may have a goods engine because the Pacific broke down at the crucial moment. Even a two-coach suburban train may one day be hauled by two locomotives owing to the fact one of the engines had to be removed to the other end of the division, and for this form of double-heading only three men are needed, while four are required to run the two engines separately. It is therefore not necessarily an anomaly when " out of place " engines are temporarily used for certain trains.

As already indicated in this series, there is an immense advantage in adhering to light railway procedure in miniature work. The larger and heavier locomotive types are in this event excluded, and there is much more freedom in the use of the engines at one's disposal. On such railways 0-6-0's and 4-4-0's, as well as even 0-8-0's, are much more freely interchangeable, and in this sphere of lighter locomotive power there is an enormous range of choice by way of the older and much more chaste designs.

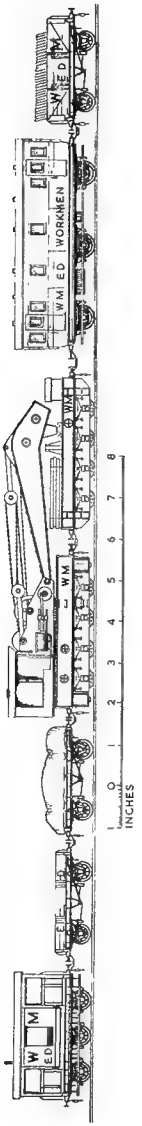
In Britain, where the weather is hard, it is the invariable custom, unless in the instance of emergency storage stacks, to store the coal for fuelling locomotives under a roof. Coaling plants should be of ample, though not too great capacity, and should be located only at divisional centres and termini. In the second plan in Fig. 7 the movements of a

locomotive at a depot are outlined in sequence, and the whole equipment illustrated, the depot being of considerable size. For a nominal layout it could of course be much smaller. At point (1) we have the arrived engine on the turntable, where it is turned. It proceeds, as a rule, to point (2) where it receives sand, coal and water. It then proceeds to the ashpits (3) where its fire is dropped and its ashes raked out. It then enters the sheds as at (4). On leaving the sheds it is now practically equipped for the roads, and after its fire has been kindled it departs from the opposite end (5) and takes the " run-around track " to the stores (6) where it receives oil and waste for its journey and leaves the yard (7) either by the turntable or (if a call at the stores is unnecessary) by the straight exit (8). The location of the breakdown track, immediately near the straight exit, is shown, and the sheers and their inspection pit have a separate track also. Standpipes for the supply of water are situated at both exits, the supply being from a rectangular tank at the rear of the yard. A complete arrangement for coaling-wagons is also included at the rear, with correct arrangements for the handling of such vehicles by a shunting engine.

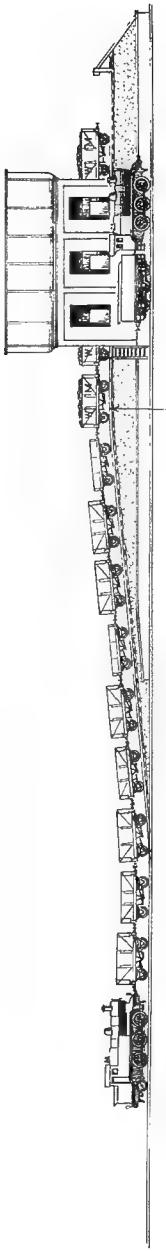
The two drawings in Fig. 9 illustrate a couple of important items in connection with locomotive depots. In the upper drawing we have the normal composition of a breakdown train, which is kept at every considerable locomotive depot in readiness for immediate despatch under the power of the nearest available engine in the event of an accident on the division. As a general rule there will be the breakdown crane itself, a wagon sheeted over to protect its load of tools, another wagon with wooden battens and props, a converted coach of early vintage for the sleeping accommodation and canteen for the workers, with a brake van and maybe an extra low-sided wagon. A breakdown train is a very characteristic feature and is well worth modelling.

The other drawing shows the procedure where it is necessary to push loaded coal wagons up the gradient of a coaling stage of the old-fashioned style, when it is forbidden for the locomotive to take the gradient itself. These grades are often very steep, and it is the usual rule that engines shall not be used on them. The method followed, therefore, is to push up the loaded wagons with the intervention of a number of light wagons if these are available. On a model layout the uncoupling ramp, or magnet, should be located at the top of the gradient. Another method of handling wagons on these coaling stages is by the aid of a cable and donkey engine located at the top end.

It is the usual practice to keep a storage of coal in case of emergency ; a hold-up in traffic or a workmen's strike may otherwise disorganise the entire work of the yard. Such storage piles are not merely dumped at any convenient point, but require to be carefully stacked. Bituminous coal will tend to fire itself if stacked in piles of a greater height than 12 ft. to 15 ft., and such a fire is most difficult to extinguish. The emergency coal stack is a familiar sight at any larger yard, and a photograph of such a storage pile at Botanic Gardens, Hull, is given in an earlier handbook of this series. They are generally about 6 ft. to 8 ft. in height, stacked in



BREAKDOWN TRAIN



PUSHING FIVE LOADED WAGONS UP A ONE-IN-TEN INCLINE

FIG. 9

approximately accurate rectangular form, and usually have a line of white paint along the sides. It is an easy matter to make such a model, a wooden form being first made and covered with black paint. When dry, this is coated with glue and sprinkled with coal which has been sifted through a $\frac{1}{8}$-in. mesh seive. A characteristic touch can be secured by shaping the wooden form as if a portion of the fuel had been removed.

As regards the running of locomotives from the depot to the trains which they are to serve, the working timetable allows for each engine crew a sufficient margin of time before the moment for their departure from the sheds so that necessary preparations can be made. When the moment of departure comes, the engine is run light to the station from which its train is to depart, this movement being fitted in between the departure and arrival times of regular trains. On a congested section, in order to save time, a number of such light engines are sometimes run together. It is now customary to reckon a train by its weight rather than by the number of its vehicles, and the first duty of the guard is to inform the driver what the total weight of the train is. The weight of each vehicle, passenger or freight, is invariably painted on its side or its ends, and it is these figures that are added together, an allowance being made in addition according to the size of the conveyed load. This ranges from 5% to 20% according to the form and extent of traffic.

Double-headed trains were a frequent occurrence in earlier days, but in this country it is now the procedure to produce such powerful engines that the practice is falling into disuse. It must be remembered that the procedure is resorted to, as already mentioned, for the purpose of running a light engine to its shed. The use of banking engines over isolated sections of the line is much more frequent, and this is quite a possible recourse in the miniature realm ; indeed it is often essential as in real practice. The worst difficulty in this respect is that of the couplings. Nearly all the automatically operating model couplings require a halt in order to uncouple ; but it is possible to dispense entirely with the coupling on the front end of a banking engine if a bar is soldered across its buffers. There is still, of course, the question of the coupling on the end of the train in front of the banking locomotive, but with careful manoeuvring it is possible to arrange the buffer bar at such a height as not to engage the hook of the van. When this is done with success, it is possible to drop the banking engine without slowing down the banked train, as in real practice. This really amounts to a matter of installing a special lead from the yard control to a section of the track, say, at a station platform. The train is run up the incline possibly at full speed, and when the leading engine has passed over the section—also at full—the yard control is set slow, so that the banking engine draws to a standstill. This arrangement is shown in Fig. 10, upper diagram, and the section-switch (SS) is installed so that the section can also be put to its normal use for a train using the platform.

It is important, in connection with banking, that the mechanisms of the two locomotives shall be of approximately the same capacity so far

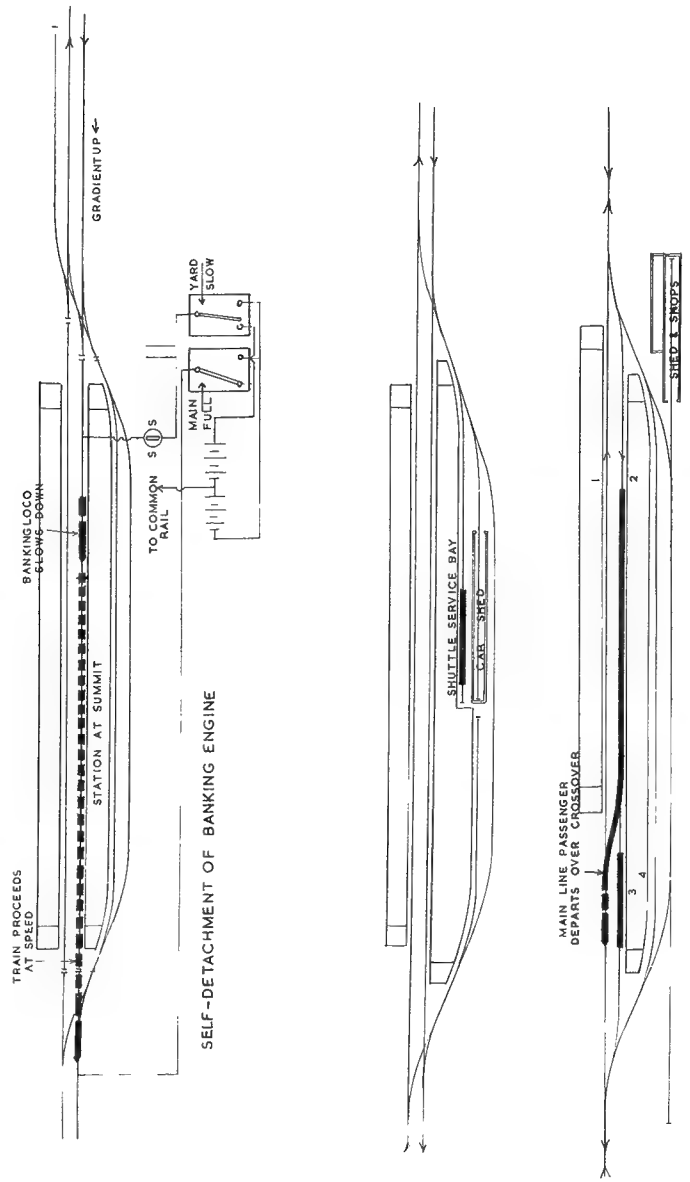


FIG. 10 PLATFORMS FOR RAILCOACH SERVICE

CLASS OF TRAIN AND HEADLAMPS (White lights)	DESCRIPTION OF TRAIN
A	Express passenger train, express diesel car, newspaper train or breakdown van train or snow plough going to clear the line or light engine going to assist disabled train or fire brigade proceeding to a fire
B	Ordinary passenger train or breakdown van train NOT going to clear the line, branch passenger train or mixed train, rail motor train (loaded or empty), ordinary passenger or parcels diesel car
C	Parcels fish fruit horse livestock meat milk pigeon or perishable train composed entirely of vehicles conforming to coaching stock requirements. Express freight livestock, perishable or ballast train piped fitted throughout with the automatic vacuum brake operative on not less than half of the vehicles. Empty coaching stock train (not specially authorised to carry "A" headlamps)
D	Express freight, livestock, perishable or ballast train partly fitted with NOT less than one third of the vacuum braked vehicles connected by vacuum pipe to the engine
E	(a) Express freight, livestock, perishable or ballast train partly fitted with NOT less than four vacuum braked vehicles connected by vacuum pipe to the engine. (b) Express freight with a limited load of vehicles NOT fitted with continuous brake
F	Express freight, livestock or ballast train NOT fitted with continuous brake
G	Light engine or light engines coupled or engine with NOT more than two brake vans attached
H	Through freight or ballast train not running under class C, D, E or F conditions
J	Mineral or empty wagon train
K	Freight, mineral or ballast train stopping at intermediate stations. Branch freight train

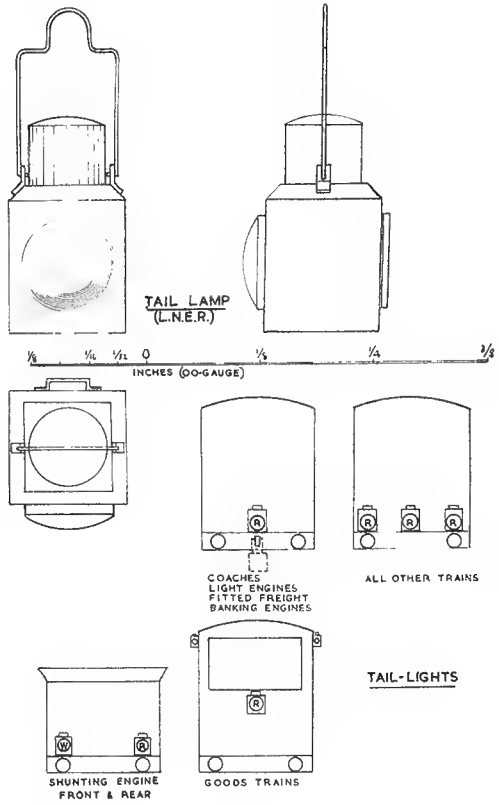


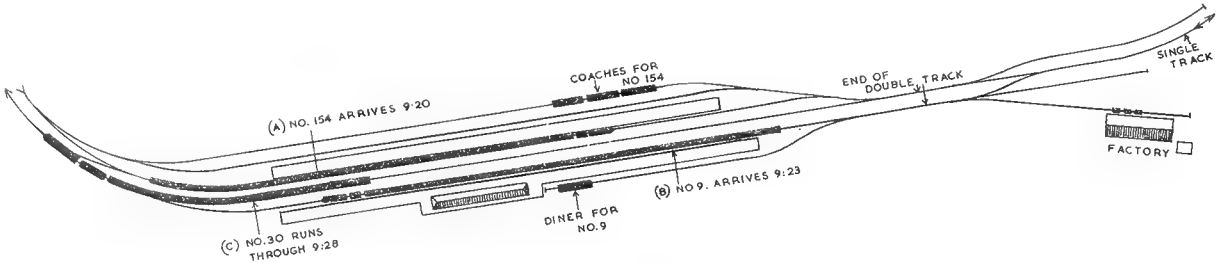
FIG. 11

as speed is concerned ; indeed, the banking engine should be capable of a slightly higher speed when let out fully. Operators frequently have had trouble in carrying out this manoeuvre, but I have watched Mr. Fleetwood Shawe controlling such movements with the utmost reliability and success, the trains taking steep grades with standard curvature without derailment.

An important item in traffic operation so far as locomotives are concerned is that of the headlight codes now in use. These have, since the nationalisation of the British Railways, been revised, and in Fig. 11 will be found the code now in use throughout the country. Miniature operation can scarcely be called complete without the use of these, since in real practice they serve to describe to the signalman precisely what type of train is approaching his box. The lamps are of course lighted at night and painted white to serve their purpose during the daylight. On the former Southern Railway the headlight code also served to indicate the routes over which the trains were travelling. On the former L.N.E.R. the common headlights were augmented by blue lights for a similar purpose, and on several of the old lines the lamps were in the daytime substituted by white-painted metal discs. The former Caledonian used to employ two white arms like the hands of a clock, mounted usually on a bracket at the base of the chimney.

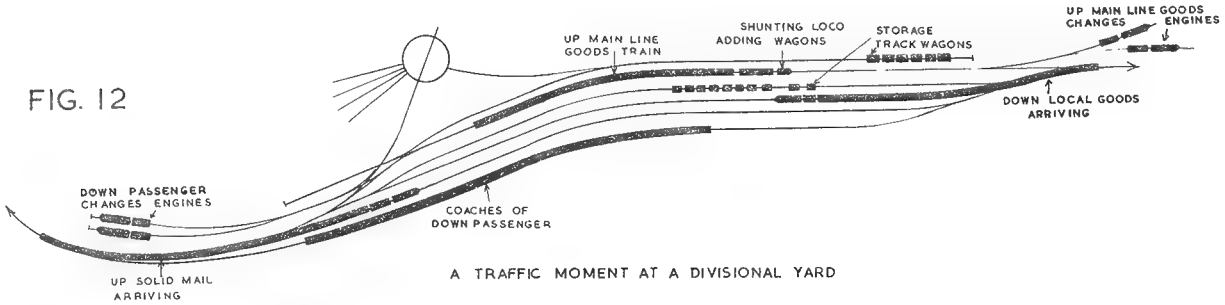
Mention has been made on an earlier page of the interest attaching to a divisional locomotive centre on a large layout. In order to give some impression of traffic operation I have introduced a couple of diagrams which are really the work of Mr. Frank Ellison, and which appeared to describe American procedure in the *Model Railroader*. These diagrams I have re-drawn in British style of running. The upper one (Fig. 12) shows the various movements at a through station over a given period of eight minutes—scaled time. It will be seen that there are three trains in evidence. Thus, at 9.20 train A arrives from the west ; it is numbered 154. It has to receive the addition of three extra coaches which are awaiting their duty on the up siding. Three minutes later, at 9.23 to be precise, No. 9 train arrives from the east and must take on a dining car ; while five minutes later No. 30, an express, runs through the station. The departure of the other two trains is of course timed to allow for this through-running train to pass. The work at such a centre of locomotive and rolling stock exchange can be extremely fascinating and can make an exacting demand on the practised hand of the operator, as well as upon his mental and nervous resourcefulness.

When we come to the actual divisional yard, devoted entirely to the changeover arrangements pertaining to stock and power, and from which pedestrian movements are eliminated, the operational work can be even more exacting, and is at the same time most engrossing. The lower of these two diagrams shows what might happen at a single given moment within such a yard, the " moment " here of course being figurative only, for the movements would occupy a considerable " scaled " interval. What is meant is that they are movements all grouped together inder a single set of operations, and probably more than one operator would be



THROUGH STATION TRAFFIC WORKING:
THREE ARRIVALS IN EIGHT MINUTES

FIG. 12


UP MAIN LINE GOODS TRAIN
SHUNTING LOCO ADDING WAGONS
STORAGE TRACK WAGONS
UP MAIN LINE GOODS CHANGES ENGINES
DOWN LOCAL GOODS ARRIVING
DOWN PASSENGER CHANGES ENGINES
COACHES OF DOWN PASSENGER
UP SOLID MAIL ARRIVING

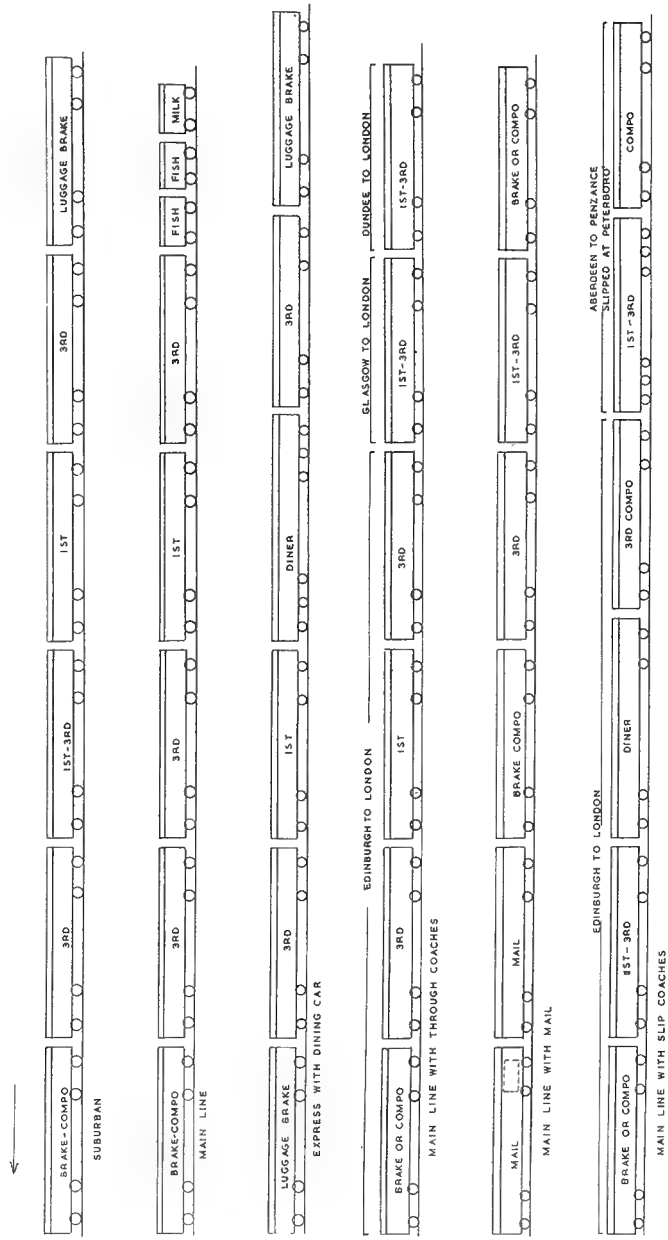
A TRAFFIC MOMENT AT A DIVISIONAL YARD

in charge. The main line is single track, and from the west a " solid " mail train is arriving, and will run through—it is hoped—without incident. On the down line a long passenger train is changing engines, its coaches standing on the down track. An up goods train of main line qualifications is also having its engines changed, while a down local goods is on the point of arriving from the east. While the engines of the up main line goods are manoeuvring, the yard shunting engine is adding wagons to its train. The locomotive depot is of course located at this centre, and other various passenger and freight vehicle storage tracks would be included.

PASSENGER TRAINS

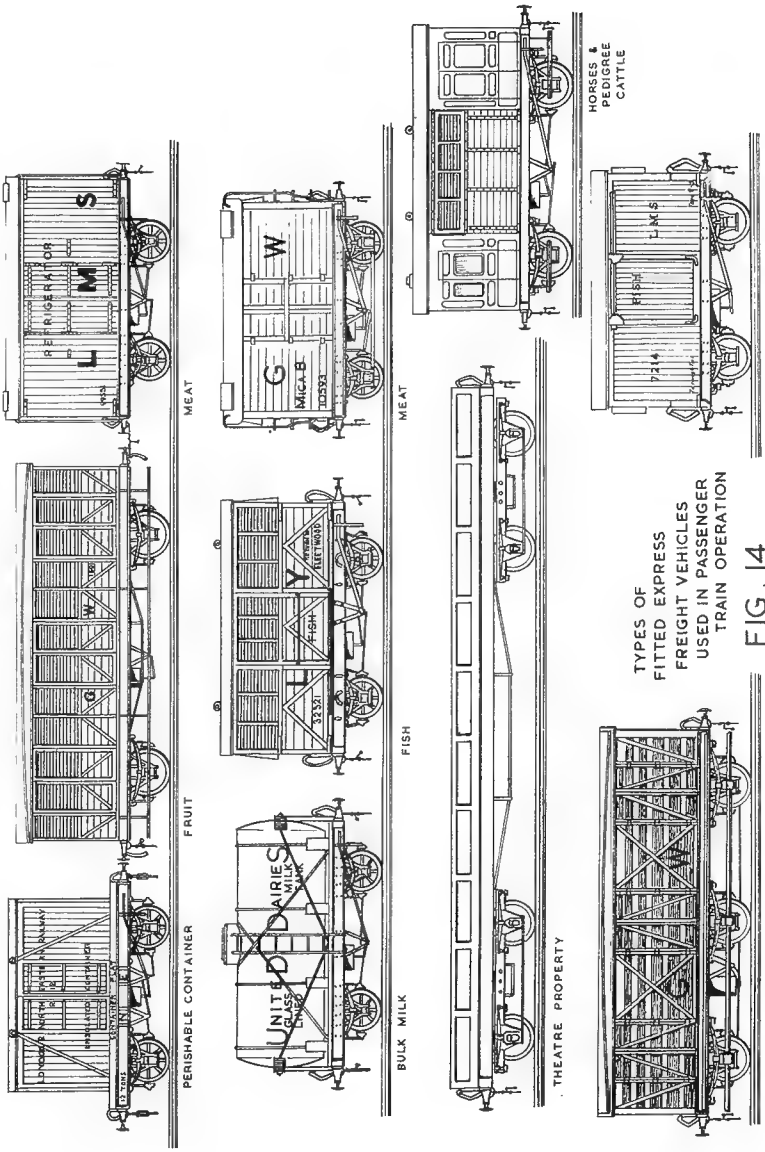
Perhaps we may now pass on to consider some of the operating conditions which govern the movements of passenger trains, with a view to deciding if and how these may be applied to our subject. And first we might attempt to answer the very elementary question : In what order are passenger trains usually arranged so far as their separate coaches are concerned ? In Fig. 13 the different types of trains are shown in diagrams —suburban, main line, express, mail, etc. In the instance of the suburban train, as indeed with all others, the centre of the train is more or less reserved for first-class coaches. In the drawing, of course, a limited number of vehicles only are shown, and on an actual train there would be more thirds and fewer firsts. The brake van, or compartments given to that function, are at each end. The rule concerning passenger brakes, however, is flexible ; one quite often finds one in the middle of a long train. Much the same principle is observed on a main-line express, and where this includes a dining car, the diner will be in the middle of the train immediately adjoining the first class. It is important that horse-boxes, fish vans and milk vans should, when attached to a passenger train for express purposes, always be attached to the rear end. In this way they can be readily dropped at their intermediate destination. Even the rule about dining cars being placed centrally is not over-rigid, for sometimes the dining car is not carried all the way ; and if it is to be dropped *en route* it will be placed at the end.

The arrangement of through coaches on a main-line express is worthy of study. Thus, in the fourth diagram, we have, as an example, the express from Edinburgh to London, which leaves Waverley around ten o'clock each day. A portion of this train runs right through from Aberdeen to King's Cross, *via* Dundee, and another portion runs through from Glasgow to London. These are conveyed as separate trains from their railheads, being attached to the train awaiting at Edinburgh. Similar arrangements can be had on a miniature system, and provide a great feature of operating interest. If mail vans are carried on passenger trains, as distinct from their being run as solid and exclusive mail trains, they are placed at any convenient position on the train, unless they have pick-up apparatus, in which event they are always placed immediately at the front.



PASSENGER COACH ARRANGEMENTS

FIG. 13



TYPES OF FITTED EXPRESS FREIGHT VEHICLES USED IN PASSENGER TRAIN OPERATION

FIG. 14

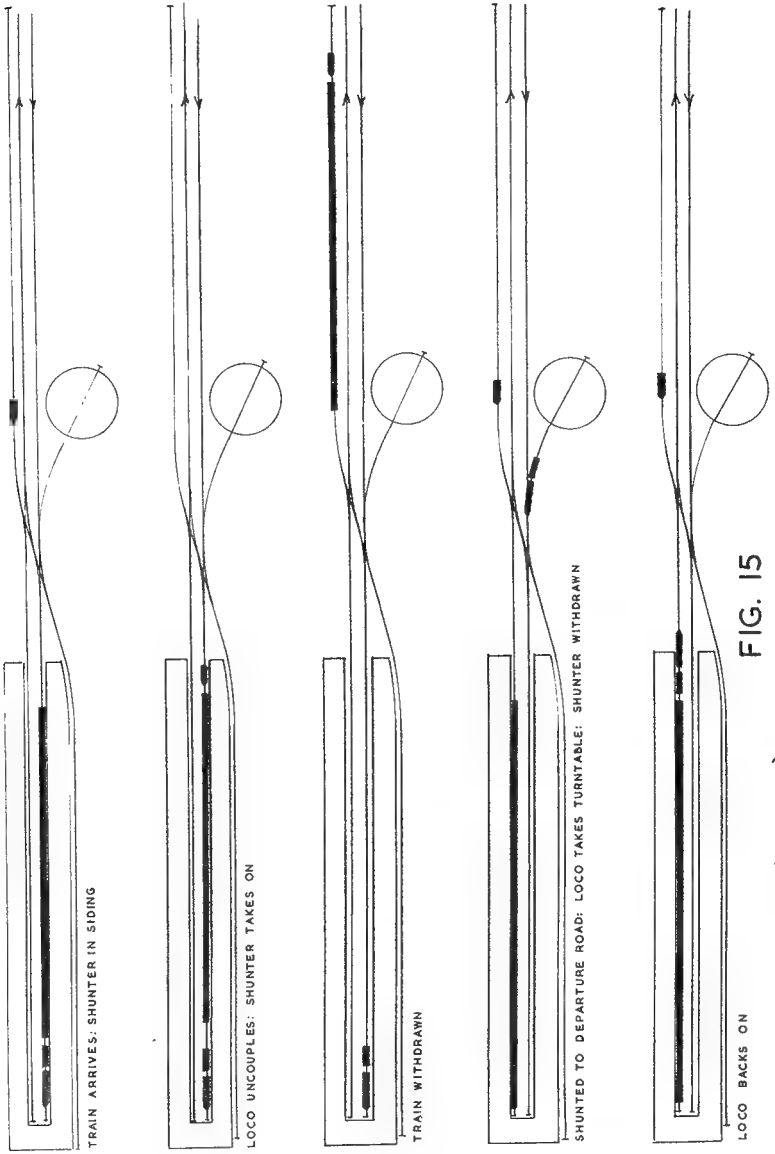

TRAIN ARRIVES: SHUNTER IN SIDING
LOCO UNCOUPLES: SHUNTER TAKES ON
TRAIN WITHDRAWN
SHUNTED TO DEPARTURE ROAD: LOCO TAKES TURNTABLE: SHUNTER WITHDRAWN
LOCO BACKS ON

FIG. 15

HANDLING AN ARRIVAL (PASSENGER)

Slip-coaches are a feature of British operation, and the slip-coach idea can be carried out quite well in miniature. For the actual operation of the slipping apparatus, all that is necessary is a slightly varied coupling on the end of the slipped portion, connecting it to the train. This should have a simple lifting hook, operated by a ramp between the rails, exactly on the principle of the auto-coupling of that type, but having a specially shaped hook of the " straight-up-and-down " kind, so that no pause is required in the running in order to operate it. A similar coupling is suggested for banking, should a hook be thought necessary.

If there are engineering conditions attaching to a given route, it is essential that all vehicles run over that route shall invariably be of a type suitable to those conditions. All vehicles must also, whether real or model, be in first-class running order, especially, for example, in the case of slip-coaches, where the slipped portion of the train must come to a gradual halt exactly where it is spotted to do so.

Empty horse-boxes and other passenger-freight vehicles relieved of their loads, are never attached to fast expresses ; they return to their headquarters by slower trains, for they would be too light for the high speed of an express. There are also special requirements to be observed with regard to all such wagons used for freight on fast trains of the passenger class. The varieties of these wagons are more or less familiar to most readers, but many would be surprised at the large range they cover. In Fig. 14 I have gathered a number of examples together, and these are not at all exhaustive. They comprise perishable-containers, fruit vans (4-wheeled and 6-wheeled), fish vans, meat vans, milk vans and milk tanks, horse-boxes and vans for pedigree cattle, theatre property vans and flats, and other similar types. It is the standard practice to have all such passenger-freight vehicles painted in harmony with passenger stock, though there are a few apparent variations. For instance, meat vans on the former Great Western and L.N.E.R. were invariably white, and on the former Southern Railway buff. On the L.N.E.R. the stock used for this purpose were painted red oxide ; on the L.M.S. and other lines they were finished in the same colours as the passenger stock, and on some roads this applied even to open fish wagons. All such vehicles are fitted with vacuum brakes.

The simple process of handling a passenger train on its arrival at a terminus—under the conditions of a model layout—is in itself worthy of observation. The space restrictions on the average scheme make it undesirable to arrange crossovers at the inner ends of platform tracks ; and these are not at all necessary. In Fig. 15 the procedure is shown. The down train arrives as in the top plan, a shunting engine awaiting it in the siding. The main-line locomotive is detached and the shunter takes on at the rear. The train is then withdrawn backwards to the siding or headshunt. The main-line engine is then run out and turned, afterwards backing on to the train which has been pushed from the headshunt to the departure track.

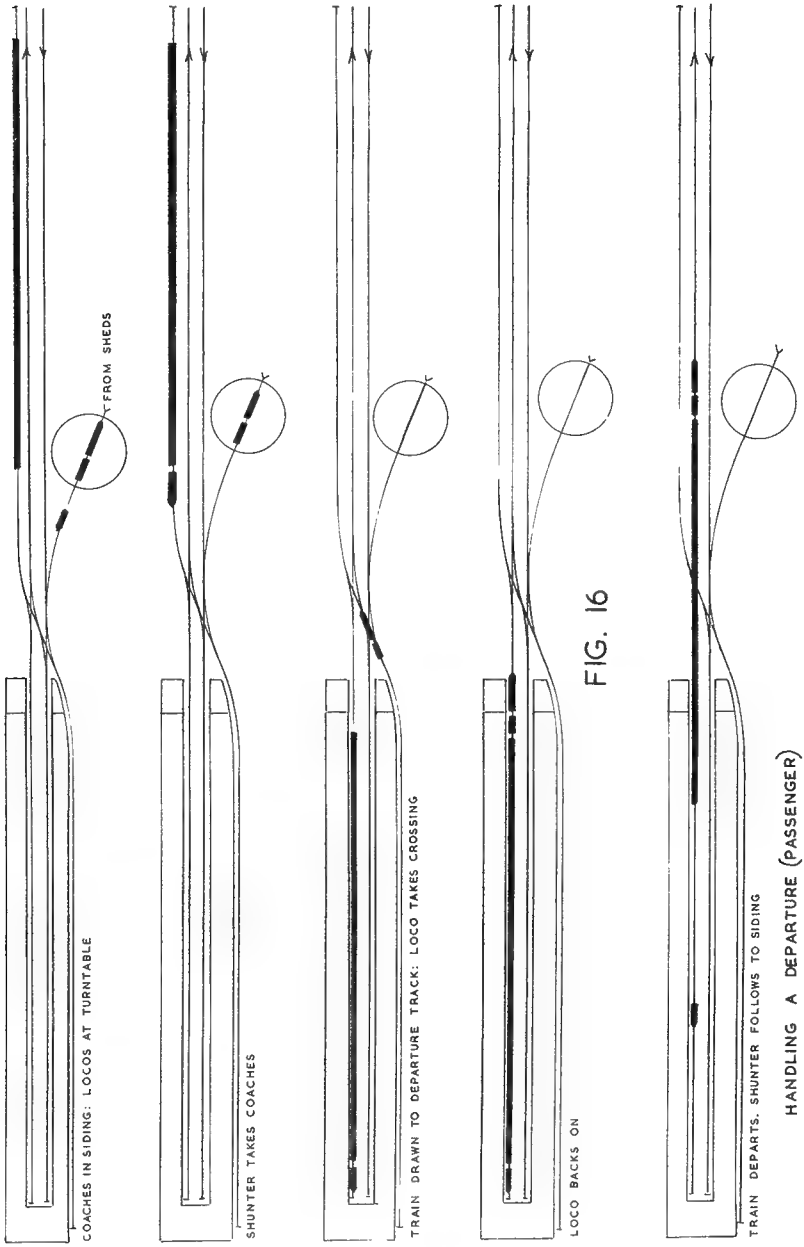
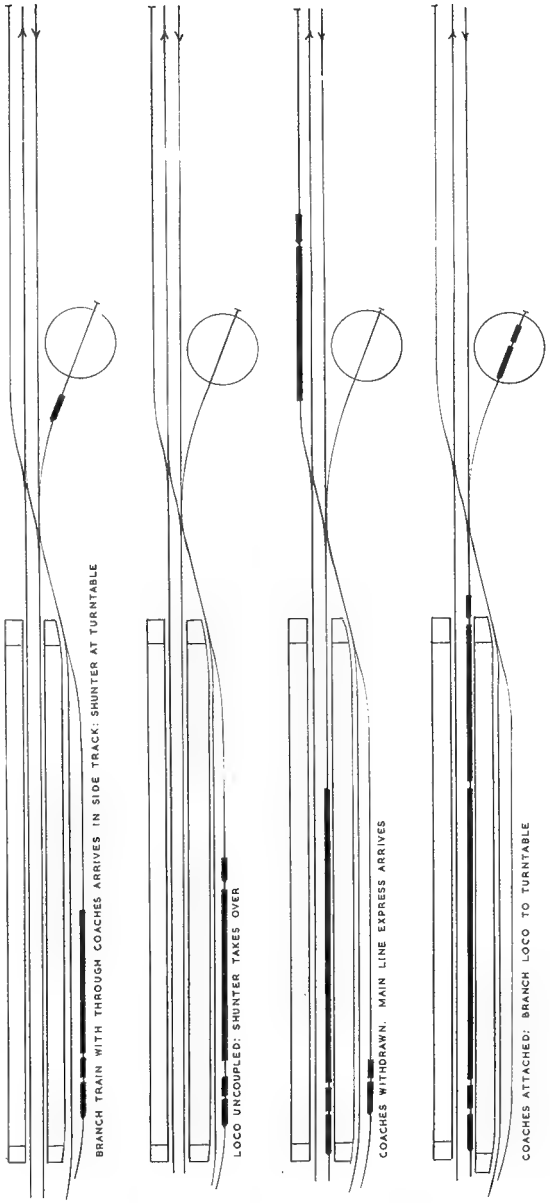

FROM SHEDS
COACHES IN SIDING: LOCOS AT TURNTABLE
SHUNTER TAKES COACHES
TRAIN DRAWN TO DEPARTURE TRACK: LOCO TAKES CROSSING
LOCO BACKS ON
TRAIN DEPARTS. SHUNTER FOLLOWS TO SIDING

FIG. 16

HANDLING A DEPARTURE (PASSENGER)


BRANCH TRAIN WITH THROUGH COACHES ARRIVES IN SIDE TRACK: SHUNTER AT TURNTABLE
LOCO UNCOUPLED: SHUNTER TAKES OVER
COACHES WITHDRAWN. MAIN LINE EXPRESS ARRIVES
COACHES ATTACHED: BRANCH LOCO TO TURNTABLE

TRANSFERRING THROUGH COACHES TO MAIN LINE EXPRESS

FIG. 17

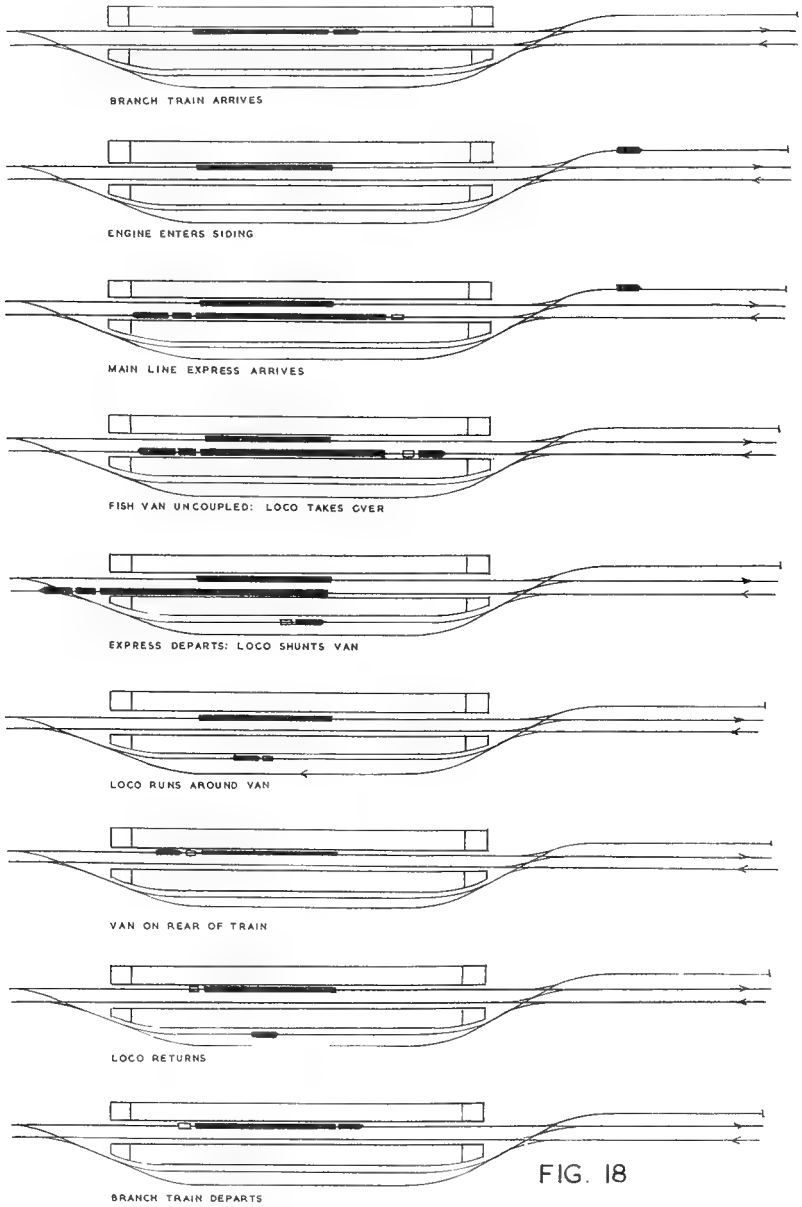


FIG. 18

TRANSFERRING A FISH VAN FROM EXPRESS TO BE DROPPED BY A BRANCH LINE TRAIN

In handling a departing train originating from the storage tracks, the procedure would be as in Fig. 16. Here, the coaches, standing in the siding, await their duties, the shunting engine being on the spur leading to the turntable, having arrived from the sheds, and a main-line engine being on the deck. The shunter takes on the coaches and draws them into the departure track. The main-line engine runs over the crossovers to the train-head and backs on. At the scheduled time the train then departs, the shunter following it out of the platform track, back to its appointed siding.

These two movements in connection with passenger traffic are probably the first to which the newly appointed operator will apply himself on his miniature system until they become second nature to him. Supposing, however, that we have before us the task of transferring a string of through coaches to a main line passing train when it halts at a through station. Consult Fig. 17. Here, in the upper plan, the branch-line train with its through coaches has arrived and has been received on the reception loop. The shunting engine is at the turntable track. The branch locomotive is uncoupled and the shunter takes over the train, withdrawing the through coaches to the headshunt. Now, the main-line express arrives from the east. The shunter backs the through coaches on to the main-line express and the branch locomotive goes to the turntable or sheds.

Supposing, again, we have a fish van arriving at the rear of an express and requiring to be transferred to a branch-line train, to be dropped on its stopping journey. The branch-line train (Fig. 18) is timed to arrive shortly before the express, and its engine immediately enters the headshunt. The westbound express then arrives on the down platform track with its fish van at the rear. The fish van is uncoupled and the branch locomotive takes it away, the express immediately getting on its journey west. The branch locomotive runs the detached van on to the reception loop and runs around it. It next withdraws the van and backs it on to the end of the branch train, returning to the head of its train and proceeding on its journey.

The idea determining all these and any other traffic movements in passenger stations is that of doing the work with the minimum expenditure of time and power. It will be found on every layout that all such movements, no matter what the track formation may be, lend themselves to their own specific and standard routine, to which the operator should accustom himself as speedily as might be.

Railcoaches are an item in passenger operation. These are usually run in the form of a shuttle service—that is, directly backwards and forwards from one terminus to another, or to and from stations serving the coaches as termini. Where this is the rule, the shuttle service will warrant the provision of a short bay in one of the platforms at which the railcoach may arrive and from whence it may leave. In Fig. 10 this idea is elucidated (see the middle plan). Alongside this short bay there is a shed with its own track for the accommodation of the coach or coaches. It may be, however, that the service consists of a circular route, for which

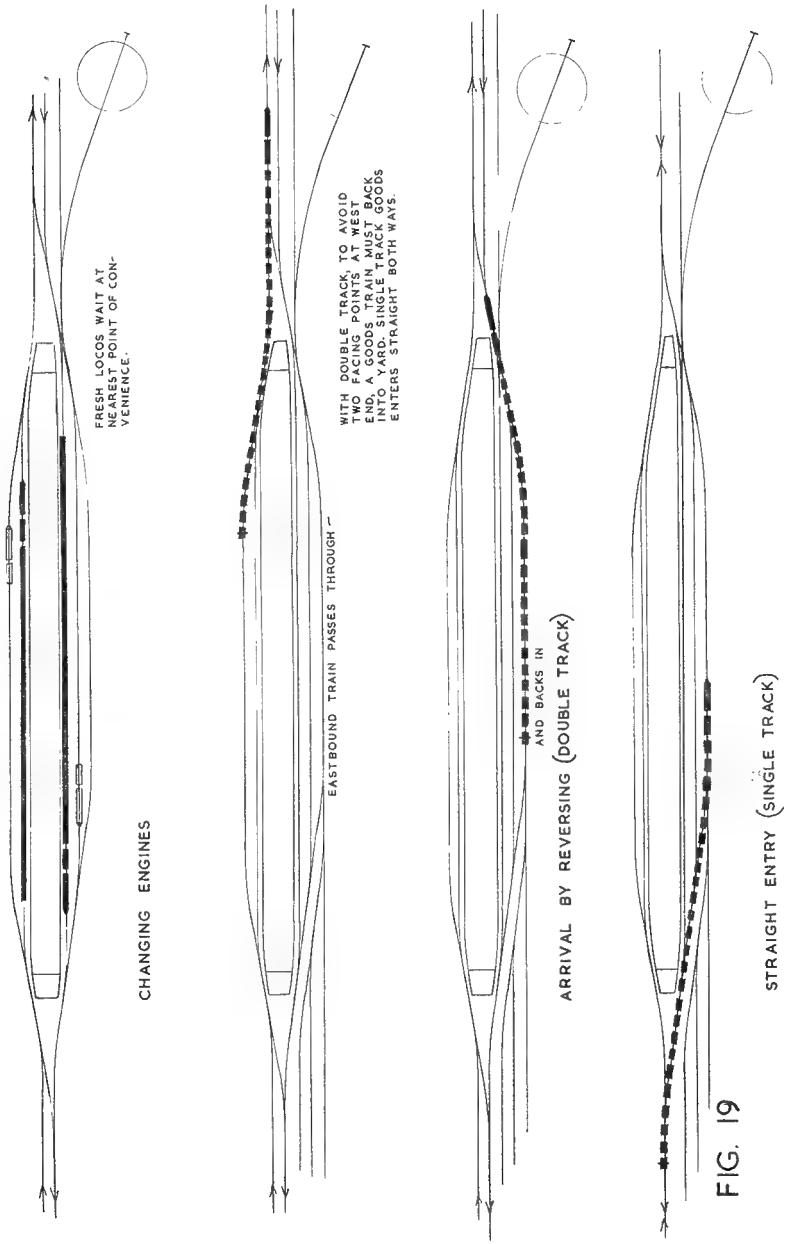
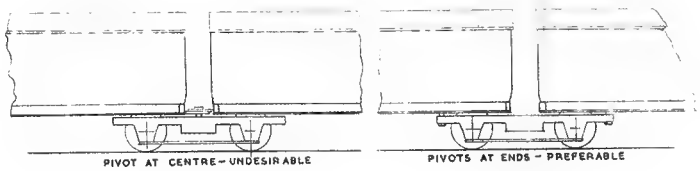
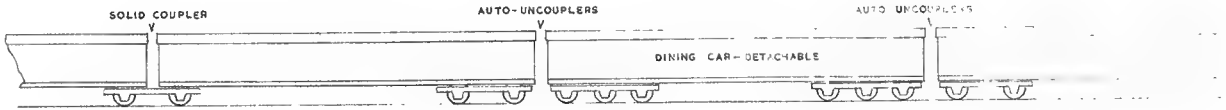

FRESH LOCOS WAIT AT NEAREST POINT OF CONVENIENCE.
CHANGING ENGINES
EASTBOUND TRAIN PASSES THROUGH —
WITH DOUBLE TRACK, TO AVOID TWO FACING POINTS AT WEST END, A GOODS TRAIN MUST BACK INTO YARD. SINGLE TRACK GOODS ENTERS STRAIGHT BOTH WAYS.
AND BACKS IN
ARRIVAL BY REVERSING (DOUBLE TRACK)
STRAIGHT ENTRY (SINGLE TRACK)

FIG. 19


PIVOT AT CENTRE – UNDESIRABLE
PIVOTS AT ENDS – PREFERABLE


SOLID COUPLER
AUTO-UNCOUPLERS
AUTO UNCOUPLERS
DINING CAR – DETACHABLE

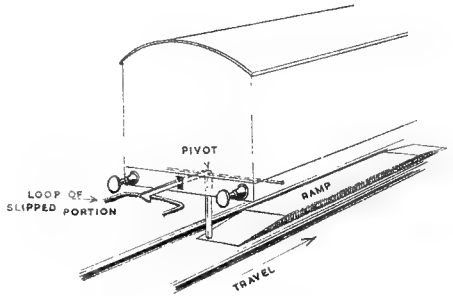

PIVOT
LOOP OR SLIPPED PORTION
RAMP
TRAVEL

FIG. 20

no terminus bay will be needed. This is the arrangement on the writer's West Midland Lines at Laurenceton. A good scheme is to isolate a short section of the platform track for the use of railcars, installing a crossover by way of which main-line trains can depart without interferring with the traffic. Note that the westbound main line here is single-track.

The changing of engines is a manoeuvre which calls for some forethought. The top plan in Fig. 19 gives a suggestion for the locating of waiting engines at the nearest convenient place on the layout, so that the arrived locomotive can be run immediately to the turntable and the departing engine at once run on.

Most operators will find it desirable to have their passenger trains coupled up in a more or less permanent form as " set trains," as this greatly facilitates running without derailments. Yet it is a procedure which cannot entirely be adhered to. Diners require to be picked up at junctions ; sleepers will require similar treatment. Railways do not as a rule carry heavy coaches on a full journey if their function is ended when the journey is half done. It will therefore become necessary to use commonsense and discretion as to which portions of full trains are permanently coupled. The best form of permanent coupling, where articulated bogies are not in use, is that which attaches to the bogie pins, above the bolsters, by means of a very thin phosphor-bronze washer. But on detachable vehicles the standard automatic coupler should be installed (Fig. 20).

One of the features of interest and importance that can be accurately simulated in locomotive and passenger train operating on a model layout is the carrying of correct head and tail lights. The present code of locomotive headlamps has already been described ; locomotive tail-lights are, in a manner of speaking, linked up with the type of train they are handling. The rule is that each train, when on any running line, must invariably have a tail-lamp attached to the rear of the last vehicle. After sunset this lamp must be alight and must show a red light, all units excepting passenger trains, fitted trains and light engines requiring also two additional lights, both red, at the sides. An engine without a train must always carry a tail-light on a running line ; but any engine on a train must not carry such lights. An engine assisting a train in the rear must also have lights, as also must all engines engaged in shunting at station yards and sidings. There must be two such lights on such engines, one red and one white, both at front and rear, the one light placed over each buffer.

There are special rules for slip-coaches and other special trains, but generally speaking passenger stock trains and light engines have one tail-lamp anywhere on the back of the last vehicle, depending where the bracket happens to be. Where there is no bracket, the light is hung on the draw-hook. Engines usually have the tail-lamp on the centre bracket at the buffer beam.

FREIGHT TRAFFIC

Before we proceed to discuss the operating procedure in relation to freight traffic, it might be well to enter into some of the small but important matters pertaining to the equipment of goods trains in miniature, these being items which really do not have reference to actual railway practice. Certain expedients are necessary or useful for the securing of realistic and satisfactory traffic movements on the part of small models. One of these, for example, is the weighting of wagons, which is to be definitely recommended. The attaching of a small block of sheet lead (fairly thick) to the underside of the floor of a goods vehicle serves to give it additional adhesion and to eliminate derailments, while the extra weight does not materially affect running since the standard voltage was increased to 12 volts. These weights should be about an inch long, wide enough to fit between the side-frames, and can be screwed to the floor with two small screws. Such weights also prove of value when coupling gear required to be soldered to some such holdfast, and this is as good as any. If the weights are neatly fashioned and fitted they rather add to the wagon's appearance.

Another important subject is that of realistically simulating wagon loads. On this subject I have already written extensively elsewhere, and it may serve our present purpose if some of these instructions are summarised as concisely as possible. Thus, coal-loads can be modelled by shaping a wooden form to fit into the top of the wagon, coming to a level slightly below the inner edge, and provided with supports to retain it there. This form is then coated with glue and covered with washed and sifted coal, being painted black before being glued. A good material for this purpose is $\frac{1}{8}$-in. balsa-wood, as this is very light and easily shaped. Gravel-loads and other minerals can be similarly produced if suitable colours are used. These loads have the advantage of doing no damage to the track if they are upset. Galvanised iron water tanks can be admirably modelled in all sizes by using dowelling covered with scale galvanised iron and painted aluminium. Labelled packing cases can be had in all styles commercially, and can be made very easily by using blocks of thick balsa-wood provided with outside battens. Steel tubes can be imitated by using lengths of wire of required thickness, neatly cut and painted red. Larger pipes, as for culverts and drains, are modelled from rolled cardboard, being provided with correct flanges or collars. These often have the name of their manufacturer painted in white block letters on their sides. Small white china containers as sold by Reeves and Winsor & Newton with artists' colours, may, when empty, be washed clean and serve for excellent earthenware sinks and washtubs. Ship's barrels of $\frac{1}{8}$-in. scale can be called into requisition for brewers' loads; and such firms

as Watneys often distribute perfectly fashioned miniature barrels which are indispensable. Iron field-gates can be soldered up from shaped wire and painted white. Small spent cartridges, when painted red, make excellent drain pipes. Timber of all descriptions can be cut from strip-wood and glued in convenient bundles. Small twigs can be selected and cut for hewn trees. First-class imitations of heavy castings can be simulated by using such items as disused gas-unions, screwed together and painted grey. Heavy tee-girders come from short lengths of brass curtain-rail. A bridge girder of the lattice kind can be built up specially from old rail and brass strips. Some years ago I received a number of such odd girders as samples, which were of no use for anything else, not being in pairs, but which made fine loads for special wagons. Miniature cars and the new " Lilliput " farm tumbrils sold by Britains Ltd., must not be forgotten. It is now possible to provide cattle wagons in oo-Gauge with full loads of scale cattle as produced by the same firm, though these must be built into vehicles before the roofs are added. Excellent tractors are also included in the same line. An odd ship's boat comes in useful for a flat or well wagon.

The making of really accurate loads of the heavy type is another branch of this work. One of the finest models I have ever seen was a miniature concrete mixer built by Mr. Ian R. Fraser. Bull-dozers and steam shovels are very effective, especially when modelled from scale drawings. For a very heavy well-wagon a fine freight is that of a model locomotive of small type in wood or cardboard, bereft of its boiler fittings and cab roof.

More important than the loads themselves is the matter of mounting them correctly. A wise plan is for the prospective operator to obtain copies of the literature issued by British Railways on the carrying of special loads on special wagons. These are produced both for the commercial public and for the employees of the railway. The importance of loading miniature timber wagons properly is an item both of appearance and of successful movement over curves. Thus, in loading heavy tree trunks or baulks of timber, numerous wagon arrangements can be resorted to. Three bolster wagons may be used, the load chained to the first and second on their swing bolsters, the third being used as a match-truck to take the overhanging ends. Larger trees may be chained to the two outer wagon bolsters, the middle bolster being removed. With four trucks, the trunks may be chained to the first and third, the other two having no bolsters. Where five bolsters are used for extra long trees, bolsters should be removed from the second, third and fifth. Tree trunks are always loaded with all their butts at one end. Telegraph poles, and regularly tapered timber are loaded with half their butts at one end and half at the other. Long, flexible loads, like rails, light poles and so forth, carried, let us say, on four wagons with bolsters, are chained to the first and the third and rest on the other two to which they are not chained. Bridge girders are treated much like heavy tree-trunks, and are of course carried upright. Short timbers like floorboards and softwood planks when they project over the ends of an open wagon are provided with a match-truck having lower sides than the loaded wagon, over which the projecting ends may

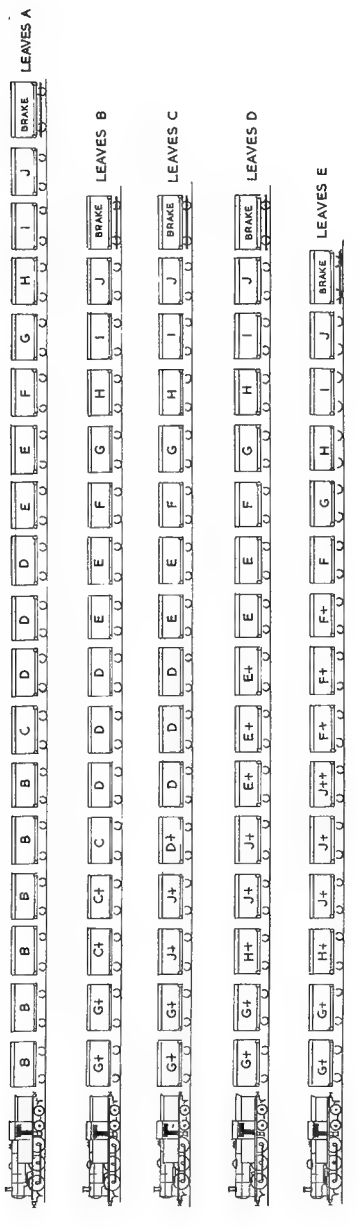
hang. Such timbers may project over both ends by the same arrangement of wagons, two match-trucks, one at each end being then provided. When rails are carried they are laid out so as to fit flatly within the web of each other. 90-ft. rails are usually carried on two long bogie flats.

Well-wagons are employed for carrying loads which would otherwise be too high for the loading-gauge. Gun-barrels have specially designed gun-wagons which are arranged in duplicating units to suit any necessary length of load. Specially built wagons are also used for transformers and locomotives. The question of using the right type of wagon for every kind of load is of great importance, and all loads must be fitted so as to cause an even distribution of weight over axles. It is also important to observe that with a special load on a special wagon, the vehicle is always placed immediately in front of the rear brake van, no matter what may be its destination. If there is more than one such wagon, all are placed together, the main purpose being that they are thus under the immediate eye of the brakeman. Where passenger coaches, horse-boxes, and such freight vehicles as are intended for use on passenger trains are carried on goods trains, these are usually placed together at the rear.

Loads which are too wide for the standard loading-gauge can be carried by rail, but the train would be a special one, and would require the line to be completely cleared for its transit. They would also need to be run as far as possible on double track sections, and of course must not be of such width as to foul bridges or platforms or other buildings. In the carrying of timber such as tree trunks, the number of wagons is conditioned by the length of the load. Thus, two bolster wagons are used for loads between 20 ft. and 30 ft.; loads over 30 ft. but under 40 ft. require three bolster wagons, one as a match-truck. Minerals are as far as possible carried in hopper wagons.

For use on express freight trains and for freight traffic on passenger trains, wagons are fitted with the auto-vacuum brake. These vehicles always bear identification marks, in the form of an "X," and their position on any goods train is usually immediately behind the engine, whether they are loaded or not. The brake pipes are all properly coupled, the additional braking power being of great importance in the manipulation of the train. When any shunting is done *en route*, the engine carries out this work with all the fitted stock attached to her.

This brings us to the whole question of the formation of goods trains. It will be a familiar fact to any novice that the [illegible] and varied range of wagons for the conveyance of different types of merchandise have all their normal and correct placing on trains, whether they be live-stock, explosive, inflammable, refrigerator, flat, tank or empty vehicles. But there are also other conditions which enter into the formation of a train, notably the question of destination. The strict rule as to the carrying function of a wagon can really only be enforced on through trains, since other trains will be constantly re-shuffled on their journey. But broadly speaking, loaded tank wagons conveying oil, tar, spirit and other inflammables are placed near the rear of a train, away from the locomotive. Live-stock and re-



CHANGED FORMATION OF LOCAL GOODS TRAIN

FIG. 21

frigerator wagons are placed when possible near the engine in order to facilitate fast shunting, and also to reduce the amount of shock in handling. Wagons containing explosives are never carried on passenger trains or mixed trains, and are never fly-shunted. In yards, they are placed on such tracks as are isolated, and engines under steam must not come to rest alongside of them. Such wagons are of course specially denoted by their lettering. In hump-shunting, wagons with inflammables must not be allowed to pass down the hump until the ladder tracks are cleared, and must clear the ladder track before others are allowed to follow.

The leading rule in wagon formation is to keep the loaded wagons ahead of the empty ones. All van doors and wagon doors must be securely shut before movement. As far as possible trains are made up to go to single destinations but where this is impossible, the aim should be to assemble the train with a view to avoiding unnecessary shunting. The principle of operating is for the slow trains to pick up wagons at intermediate stations and to convey them to the chief marshalling centres, where they are arranged as far as practicable into trains for given destinations or stated districts. The slow trains do not usually carry wagons for any other destinations than those on its stopping route, and it is these trains which, curiously enough, give occasion for the most difficult and tricky problems of arrangement.

Supposing that a local goods is scheduled to run from Station A to Station J, calling at Stations B, C, D, E, F, G, H, and I in its journey, then the wagons for all these stations would be attached in the first instance (at A) in their order for shunting. Wagons for B, for instance, would be next the engine, those for C following, and so on. All that is plain going ; but on the journey other matters enter in. Vehicles for the various stations *en route* would be picked up, and as this is done they are placed immediately behind the engine. When this collection of wagons has begun to accumulate, the train is re-sorted on its way.

Let us take a glance at Fig. 21, in which I endeavour to give some notion of the changes that will occur on such a train. It will be seen that, as already stated, the train leaves Station A suitably arranged for dropping wagons *en route*. When it leaves B, all the B's have disappeared, but two vehicles have been picked up for G, and two additional ones for C. Leaving C, the C's have been dropped, but two J's and a D have been taken on. This work continues until the train leaves E ; but at E there have been taken on still more, including a second instalment for J (marked J++). Before the train departs from G it is re-sorted ; and as it takes on still more for J at H, it is there re-sorted again.

There is nothing so desperately complicated about all this, unless some of the vehicles are fitted stock. In Fig. 22 we will see what happens to any fitted wagons gathered on the route. These are placed, according to rule, all together next to the engine, as we have stated earlier. They are marked with an X in the drawings. As it proceeds, therefore, the engine really gathers up two trains, one fitted and one not fitted, and these may or may not be re-sorted according to the dictates of conditions.

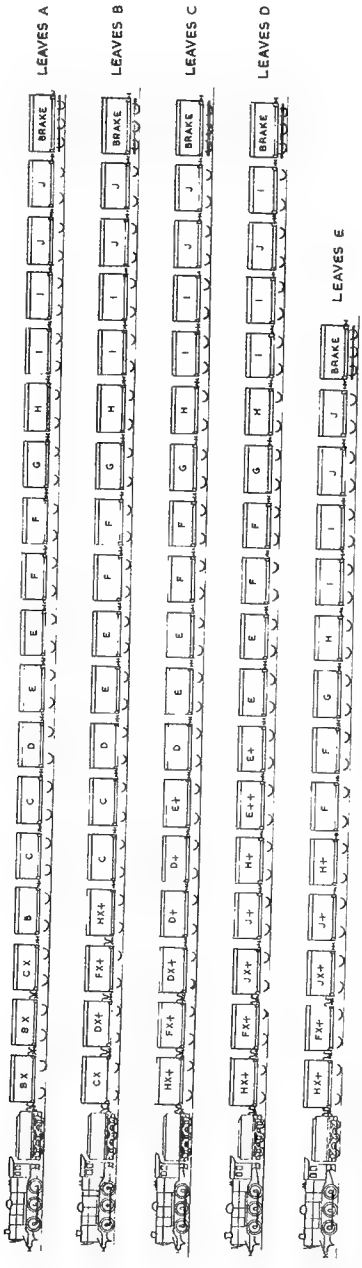


FIG. 22

CHANGED FORMATION OF LOCAL GOODS HAVING CERTAIN FITTED STOCK

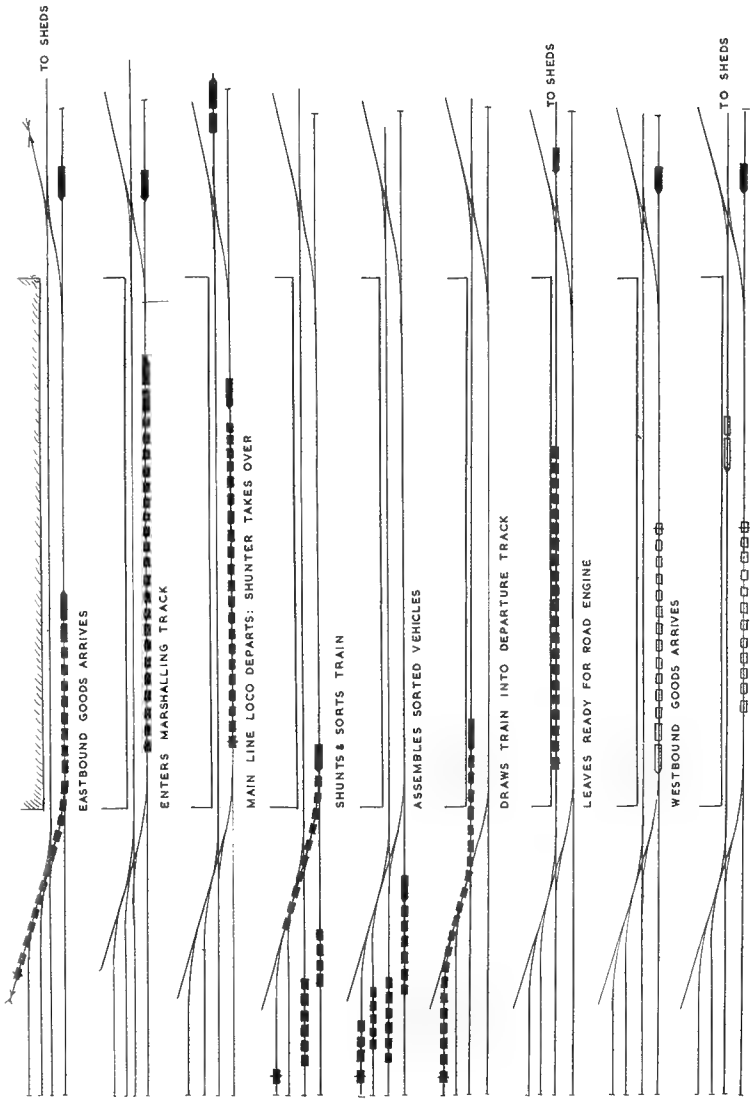


FIG. 23

SORTING A GOODS TRAIN

Should J be a station of considerable importance, or should there be a large number of consignments for that destination, these wagons for Station J would not be forwarded on a stopping train, but would be run on a " through goods " to their destination. The same applies to any wagons on a possible branch line starting from J. Sometimes a " through goods " will have a long journey before it, upon which there are several such junctions for branch lines, and the wagons for these junctions would be dropped on the way.

The ordinary arrival and departure of a goods train is a matter for correct manipulation also. Turning to Fig. 19 we see that there are two methods of drawing into a station, one by reversing and the other by a straight run. There are hundreds of stations in Britain, especially on the lines in the south, where a goods train from one of the two directions requires to reverse in order to get into the arrival track. The reason for this is in order to avoid facing points on the main line. With single-track, of course, there is no such problem, one facing point being necessary in any event. The train may therefore enter without reversing.

Fig. 23 shows the various operations and movements involved in the shunting or sorting of a goods train on its arrival. The seven upper diagrams refer to an eastbound train, while the remaining two apply to a westbound. The eastbound arrives in the reception road, a shunting engine awaiting it in the spur. The road engine departs, if that is the arrangement, and the shunter takes over. The train is sorted as required, and re-assembled in its new formation. It is then drawn into the departure road and left ready for the eastbound road engine. When the train is westbound, the procedure is the same, but for the fact that the road engine requires to run around the train before leaving for the sheds.

The movements in connection with the dropping of wagons from a local goods are given in Fig. 24, where a westbound goods enters the yard on the arrival track and is backed into a siding, or a shunting neck. The cut is detached and its locomotive runs round it. The wagons in the cut are shunted where required, and the locomotive takes the train-head for departure. If there are wagons to be picked up, they are lifted by the engine before the arrived train is broken, and are kept in attachment to the engine while it shunts the cut.

The value of what may be termed a two-ended siding is shown in Fig. 8, this being the prevailing standard forming the basis of most goods yards, especially in the miniature. The run-around track enables the locomotive to get from one end of its train to the other and thereby readily to cut out a vehicle from the innermost part of the train. The halving of an arrived train when it is too long to be accommodated on the headshunt of the yard is shown in the same figure. One half of the train is pushed back out of the way while the forward half is sorted, after which the remaining portion is taken up and dealt with. It will be obvious, therefore, that headshunts for goods traffic need not be exceedingly lengthy, though for passenger trains, where solid coupling is resorted to especially, the headshunt should be suited to the full length of a train.

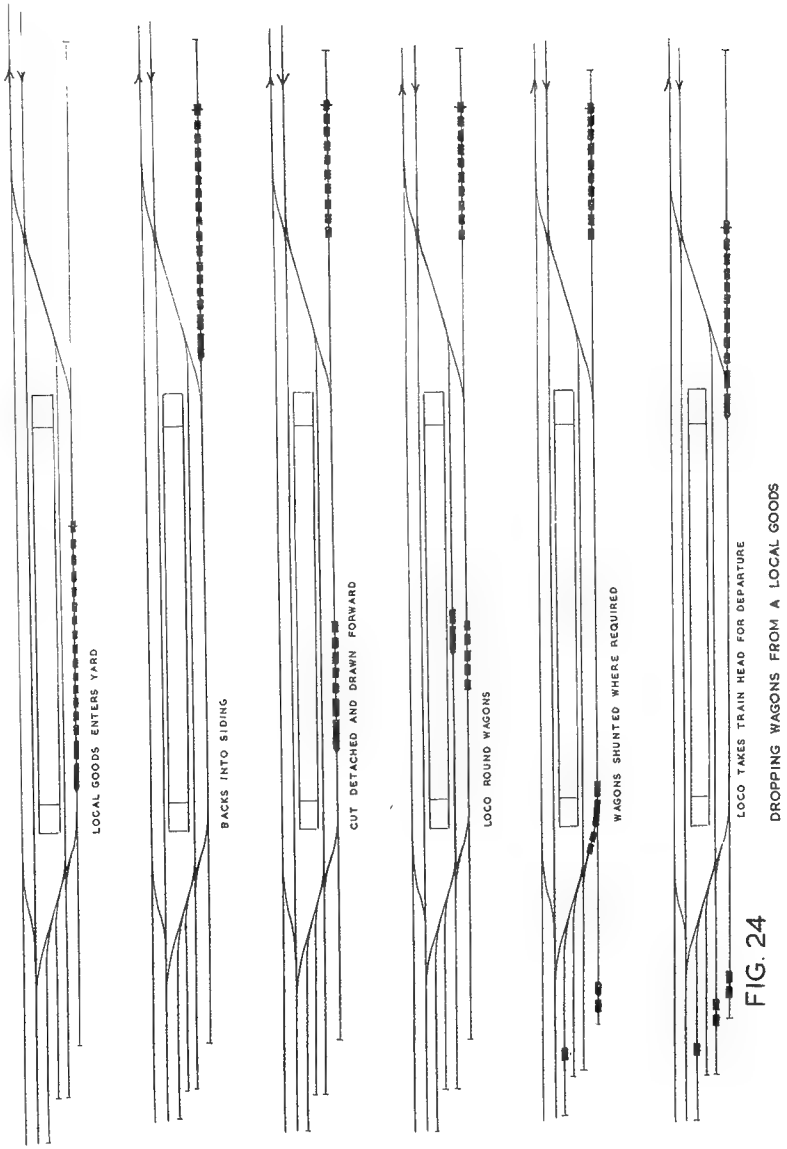

LOCAL GOODS ENTERS YARD
BACKS INTO SIDING
CUT DETACHED AND DRAWN FORWARD
LOCO ROUND WAGONS
WAGONS SHUNTED WHERE REQUIRED
LOCO TAKES TRAIN HEAD FOR DEPARTURE
DROPPING WAGONS FROM A LOCAL GOODS

FIG. 24

Shunting in yards is restricted to a speed of about 2 miles per hour which, in miniature, is so slow as almost totally to prohibit the possibility of derailments. It should be noticed that there are several forms of shunting as adopted by actual railways. The orthodox form is seen when the wagon or wagons are shifted to their required place by the engine before uncoupling, and this order of shunting is generally only applied to coaches, dead engines, explosives and live-stock loads. The most common form is loose shunting in which the vehicles are uncoupled from the train and given a push by the engine, thereafter running under their own momemtum until stopped by the brakeman. Double shunting takes place when the wagons, after they have been " loose shunted," have the points moved between them by the brakeman while they are running. This a dangerous practice and is usually forbidden. Fly shunting is almost never allowed. It consists of the wagons being pulled by the engine, the latter being detached while running, the points being operated after the engine has cleared them. It need not trouble us here, for in miniature it is impossible. The important feature of all shunting within yards is that of keeping the main line clear, and in the ordinary way, no arrangement is permissible which involves the occupation of main lines by yard trains, unless merely in the instance of a crossover, say, from a headshunt to a track.

A few words may be desirable on the subject of goods train tail-lights. The details of these are given in Fig. 11, which includes a diagram for a typical standard lamp as formerly used on the L.N.E.R. The design is approximately accurate, and should serve as a guide for such a minute model. The same lamp serves for passenger traffic. The brake-van side-lamps are of a simpler and smaller design. The difficulty with these side-lamps is that they are in real practice changed to suit variable conditions and positions of the train on its journey. The rules provide that goods trains must carry side-lights showing a white light *forward* on the rear brake van after sunset, or during fog or falling snow. Indications to the *rear* must be as follows :

On main lines, fast lines and single lines two red lights ;

On slow lines, lines adjoining main or fast lines running in the same direction, and on relief lines and goods lines—one red light (on side farthest away from main line) and one white (nearest main line) ;

On goods lines adjoining slow lines two red lights ;

On reception sidings, side-lights to be removed when train has passed into the sidings.

On miniature layouts, however, there need not be much trouble in this matter of changing the lights, since there will be few instances indeed of slow lines adjoining main lines, and therefore the ordinary fast line procedure, along with that of the reception siding, can be readily resorted to.

MIXED TRAINS

The operation of mixed trains will be called for on certain occasions within the restrictions of a miniature layout, especially if it is run on light railway principles. That is to say, if the railway takes the latter form there will be a much wider legitimate scope for the running of such trains. The Ministry of Transport have laid down very definite rules regarding the operation and formation of mixed trains, and the enthusiast would be well advised to pay due regard to them.

The anomalous factor which arises when both goods and passenger vehicles are run together on one train, of course, centres around the matter of brakes. It cannot always be guaranteed that freight wagons will be vacuum fitted and this introduces an element of potential danger. The following conditions are therefore insisted upon in such instances: the engine, tender and passenger coaches, being always fitted with continuous brakes worked from the engine, are placed together at the head of the train, the goods brake van being at the extreme end; there is also a limit as to the number of goods wagons permitted on such trains, only ten such vehicles without brakes being permitted with each 10-ton brake van, and if there are more wagons there must be more brake vans, though it also serves the same requirement if the tonnage of the brake van is proportionately increased. Thus, a 13-ton brake is used for 15 wagons, a 16-ton brake for 20 wagons, and so on. But in no instance is the total number of vehicles on a mixed train permitted to exceed thirty.

With regard to the operation of such trains, it is stipulated that they must not make a longer run than 10 miles without a stop, though if two stations are more than 10 miles apart the rule does not apply. It will therefore follow that on a miniature line a mixed train will make many station stops, and will never be run as a non-stop long-distance unit.

Should the average speed of the railway be more than 35 miles per hour, no more than half the number of trains are allowed to be mixed, and if the average speed of the railway exceeds 35 miles per hour then special permission can be obtained to run more than this proportion of mixed trains. The exceptions to this ruling come into force on a miniature system when it is given the character of a light railway with a train speed not averaging more than 25 miles per hour. In this instance, all trains may be mixed.

Horse, cattle and live-stock trains with vehicles added for the conveyance of passengers are also classified as mixed trains, though if there are passenger coaches, the attendants travelling with the live-stock occupying

separate compartments, the latter are not counted as passengers, and the train is not classified as a mixed one. When a passenger coach is added for such attendants it is run next to the engine and must have continuous brakes.

There is another form of mixed train that is not so classified. I refer to a goods train on which passenger coaches are run as empties. In this instance, such passenger stock is not run next to the engine but at the end of the train immediately in front of the goods brake. Coaches of over 60 ft. in length are never handled on goods trains, and the rule for placing other passenger coaches applies also to such passenger stock as horse-boxes, fish vans, milk vans and carriage trucks. The reason for this is that passenger stock on such goods trains is not available for braking the train, since many of the goods vehicles are not fitted or piped.

SINGLE LINE

The main requirements for single-line railways—which is the form that many miniature layouts may take—are (1) the presence of passing loops at all stations as well as at stated intervals if the stations are far apart, and (2) a suitable form of signalling. Loops are essential, of course, in order that trains travelling in opposite directions may pass each other; so here is one track-laying condition to be observed by all who plan a single line. A more complex item is that of signalling. The prevailing system in use on British lines is that of the staff or token, though the semaphore system also figures largely, both starter and block signals. In miniature, the staff system can actually have no real place, or even a working substitute, since it involves a token passed from man to man at the trackside. So it follows that some simple form of block semaphore or colour light signalling will require to be resorted to. Even when the staff system is employed on real railways it is the practice to install home and starting signals. On light railways, again, distant signals are dispensed with unless the stop signal cannot be seen within a quarter of a mile.

TIMETABLE WORKING

Since the miniature layout is reduced in scale so far as size and track-length are concerned, it follows that a clock registering time in the ordinary way can scarcely be worked to at its face measurement of the hours. A great deal has been written on the subject of scaling down actual time to suit the miniature system, and there are many ways of getting over the problem. In such an attempt at scale operation, 30 ft. per minute in 00-Gauge will almost represent 30 miles per hour. In 00-Gauge, 4m/m. equals 1 ft., so that one actual foot will represent 76 ft. Thus, a distance between two stations in this scale, being, say 20 ft. will actually represent 1,520 ft. By using a clock running at, let us suppose, ten times its normal speed, this distance is further increased tenfold, so that the imaginary distance between these stations will be 15,200 ft. Also, a main line of 500 ft. long will represent, with the co-efficient of ten, about 72 miles. While it is not claimed that these figures are meticulously correct, and while the co-efficient of ten times is quite arbitrary, it will be seen that it is convenient and handy, since a period of 24 hours will on the scale clock be some $2\frac{1}{2}$ hours.

The actual securing of scale time on an ordinary clock can be undertaken in various ways, much depending on the clock itself. No general rule can be applied to all types of timepiece. It may be found sufficient to lift off the pendulum if the clock has one, and to mark what difference in speed that causes, taking the even figure as a co-efficient. Thus, should the speed be seven times faster, that will be the figure. The clock, again, may be left alone, it being enough to count 6 minutes of its time as 60. Or a more convenient co-efficient may be taken as twelve times, so that 5 minutes will represent 1 hour, and 1 hour 12 hours, a day then being 2 hours, 1 minute representing 12.

But assuming that ten is chosen as the figure, it may be worth while to quote some useful notes which appeared in the *Model Railroader* in 1949 from the pen of Mr. Wayne Lincoln, the instructions applying to the alteration of an electric clock by the General Electric Co., series 1H.

> " First, of course, you have to take the clock out of the case, remove the hands, and unfasten the works from the back of the face. Now take out three screws and lift off the large motor-frame piece. The gear train will be exposed. Remove the top two gears and you'll have an arrangement that looks like Fig. 25.
>
> Gear A must be replaced by a 32-pitch, 16-tooth spur gear. It should have a $\frac{5}{16}$" hole and be .020" thick. I used Boston Gear Works G99 after hand-drilling the hole out and filing it to the correct

thickness. I found that by soldering the gear to a brass block I was able to hold the assembly in a vice for filing (.020" is just over $\frac{1}{64}$").

Gear A is held in place by a triangular metal spring-clutch plate that allows it to be turned independently of the shaft for re-setting. The clutch is fastened to the shaft by an enlargement of the shaft end. The clutch can be removed if you squeeze the shaft down to its normal diameter with pliers.

Now replace gear A with G99 (see that it rotates freely) and trim the points of the clutch so they don't extend beyond the inner face of the gear teeth. Bend the clutch, if necessary, to apply friction to the gear. You can enlarge the shaft end again with the point of a jeweller's screw-driver.

Take a 32-pitch, 18-tooth spur gear (Boston G100), slip a piece of $\frac{3}{16}$" tubing in the hole as a bushing, and place it over pinion B. If the I.D. of the tubing is greater than the pinion, you must solder it. I found that a flattened-out lock washer under the gear gave me the proper height location. See Fig. 26 for these assemblies.

Reassemble the clock but omit the second hand. It serves no purpose because it operates independently of the gear train and will have no relation to the movement of the other hands.

If you use more than one scale clock, they should be wired through a common toggle switch so they can all be cut out for temporary suspension of operation, then started again without resetting."

There is also obtainable in America a type of clock which has, besides its ordinary timing mechanism, a motor attached for the purpose of making up lost time in the event of a stoppage. This additional motor operates the clock at ten times its normal speed and it should, under the power of this second motor, be precisely what is wanted for scale timing. I mention the fact here because it might be possible in due course to obtain the same commodity in this country. The clock, which is of course electric, can be obtained from Edwards Brothers, Madison Avenue, New York.

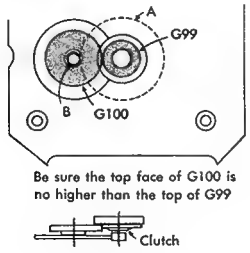


FIG. 25

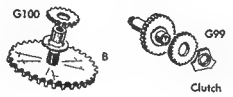


FIG. 26

One thing also needs to be emphasised while discussing the subject of scale time—that while a miniature main line is only a very minute fraction of the length of an actual main line, a miniature marshalling yard or station is not nearly so much out of proportion. A perfect scale model of a station layout might take up a space of 30 ft. by 12 ft.; but a perfect model of the main lines to the two adjacent actual stations would probably involve a length of a quarter of a mile. There exists this unfortunate disparity between main line and station layout. It therefore happens that scale time does not apply so perfectly to a yard as to a main-line track. Moreover, the time allowed for shunting operations within a miniature yard must be greater in proportion than the time allowed for a main line run. A model yard is not foreshortened to any great extent, and shunting will require much the same movements as those involved in an actual yard. It may therefore be necessary, in addition to running by a scale clock, to make some kind of compromise between the yard time and the main-line time, allowing more time for shunting, proportionately, than for running.

With these conditions, then, in mind, the question arises as to how to set about the making of a timetable for a miniature system. As will be generally known, there are in real practice two types of timetable—the form issued for the travelling public, and the working timetable as produced for the guidance of the staff, The second type is very much fuller and more detailed than the first, containing as it does, not only the details of passenger and mail trains but also the movements of freight trains and locomotives and the times when non-stop trains are due to pass all stations. For a miniature layout, the second type is the one to aim at. When it is formulated and complete, it is an easy matter to compile a so-termed public timetable for the guidance of onlookers.

In undertaking this task, then, have first in mind how many operators there are going to be. If the number is usually to be one only, the trains should be scheduled so that they do not as a rule overlap one another in their running. If on some occasions there are to be more operators than one, perhaps a special timetable might later be evolved for these occasions. Or, should the sole operator desire to give himself a complicated and tricky job, let him overlap the runnings as he sees fit; I am merely giving a word of caution. Something will also depend upon whether trains are to overtake and pass each other *en route*—whether there are to be waiting sidings for slow trains, and so forth. My point is that, even if the departures and arrivals are nicely dovetailed to suit each other, there will be enough to occupy the dexterity and attention of the single operator by way of fitting in the locomotive and shunting movements involved. The schedule must also be arranged in the light of what coaches are available at given places and at stated times. Thus, in running a passenger train to an outlying terminus it will be most convenient to arrange for a return journey as immediately as is reasonably possible; and at all events a precaution must be taken not to tie down too much stock in one place, where they will be stranded and out of commission.

Create your schedule, in the beginning, on fairly simple lines, and be

content to work with it for a period. More complicated arrangements may be introduced later. Let us assume that we are starting with a working day beginning at 10 a.m., and that the stations to be served as are indicated in the table Fig. 27. Let the first run be that, say, of a passenger train from Greenelms to Colstead, stopping at all stations, and taking 1 hour 26 min. on its journey, scaled time. Its journey is set down in the first column, the operation beginning with Locomotive No. 281 leaving the sheds at Greenelms at 9.45 a.m. The train departs at 10 a.m., and the arrival and departure times for each station are shown. Laurenceton is the largest station on the route, a divisional point between two companies' tracks, and on arrival there the engine is changed, No. 396 being substituted. This locomotive is timed to leave the sheds at Laurenceton at 10.40 a.m., the train being due at 10.42 a.m. An interval of 14 minutes is allowed for engine changing and for coach shunting involved.

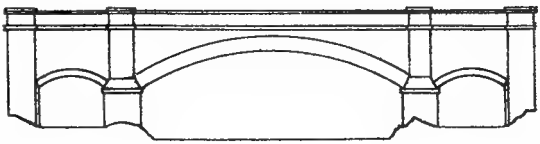
The next train is a goods perishable express from Greenelms to Laurenceton Hump Sidings. It should be noticed that on the timetable the goods stations are shown as well as the passenger stations, if they are on separate and distinct routes. This train makes no stops, though its total speed is slower than the passenger train before it. It makes the journey in 2 hours 14 minutes.

Meanwhile, we remember that No. 396 and its train are at Colstead, and the next run may be from that station back to Greenelms. The figures in brackets show the times when non-stop trains are due to pass their stations. This 1.53 passenger from Colstead halts only at Laurenceton, where our old friend No. 281 again takes over. A mail train of the " solid " type next follows, running from Greenelms only as far as Laurenceton, non-stop, and making the trip in slightly under the hour.

Other trains will be scheduled on suitable timings and will doubtless comprise slow goods, passenger expresses, specials, stopping local trains, fast and local goods to and from the docks and hump sidings at Laurenceton. There is really no limit to the interest, the principal thing to watch being the location of arrived trains and the distribution of stock and engines, the rule being to return locomotives ultimately to their headquarters in full service. A timetable of this order is quite simple, and is most fascinating both to create and to operate at regular periods.

Complications set in when runs are overlapped so that one train leaves its starting point before another arrives at its destination. It will, I think, be found that apart from the complexity of this form of working, and the need of supervising more than one running unit, there are endless " odd " tasks to be carried out at whatever convenient moments can be secured between the simple runs already described. There will be shunting at the hump yard and docks, the formation of trains, the marshalling of goods wagons, the taking up and dropping of dining cars and sleepers, work at wayside factories, the handling of through coaches at the divisional centre, and the coaling and watering of locomotives, for all of which time-allowances must be made on the schedule.

These complications will of course simplify themselves when there is more than one operator, and especially in the instance of a club. Here, the various duties may be allocated to different men, one being in charge of the hump and docks, another working trains in and out of the termini, and a third in charge of main-line traffic. It will also be found by the lone operator that in due course, with practice and use, a more advanced form of schedule will be desired and can be worked. My purpose has simply been to formulate some simple procedure whereby the beginner in the fascinating work of operation might make a practical start. The time taken by each train on its journey on this tentative schedule is entirely an arbitrary figure ; the correct method of discovering the periods required for any journeys is simply that of running the trains over the layout and finding out how long they require, whether slow or fast goods or expresses. A similar procedure with regard to locomotive movements and shunting will serve to furnish an idea of periods demanded for these operations. A certain amount of overlapping is possible when, for instance, a locomotive might be run from its shed at one depot while a main-line train is *en route* elsewhere on a non-stop and lengthy run. In due time these possibilities will suggest themselves to the operator.



	PASS.	GOODS		MAIL.
	A.M.	A.M.		P.M.
GREENELMS	NO. 281 9-45 10-0 DEP DC	NO. 51 11-30 11-36 DEP		NO. 291 2-50 2-58 DEP
EAST OAKS	10-10 10-12	(11-58)		(3-18)
METHVEN HIGH	10-30 10-33	P.M. (12-30)		(3-38)
LAURENCETON	NO. 396 10-40 10-42 10-56			3-54
HUMP SIDINGS		1-50		
DOCKS				
METHVEN LOW	11-5 11-9			
COLSTEAD	11-26			
			PASS.	
			P.M.	
COLSTEAD			NO. 396 1-52 1-53 DEP	
METHVEN LOW			(2-14)	
LAURENCETON			NO. 281 2-15 2-20 2-23	
DOCKS				
HUMP SIDINGS				
METHVEN HIGH			(2-30)	
EAST OAKS			(2-42)	
GREENELMS			2-56	

DC – DINING CAR

FIG. 27

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OTHERS TO FOLLOW

Edward Beal's

RAILWAY MODELLING SERIES

Book Nine

MAINTENANCE

3/6

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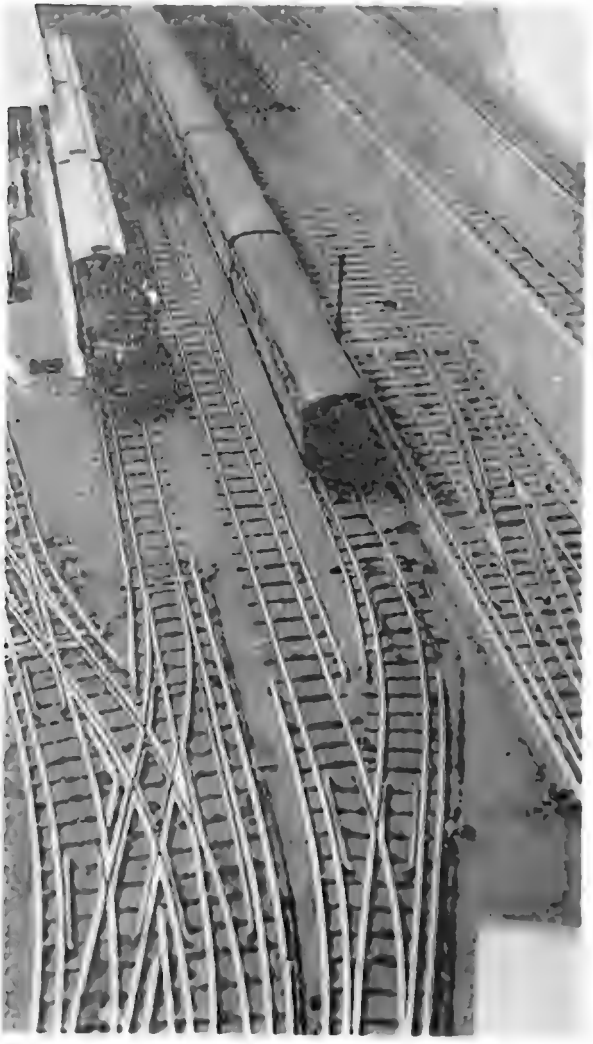


SOME WELL KEPT
THREE-RAIL TRACK

ON MAINTENANCE IN GENERAL

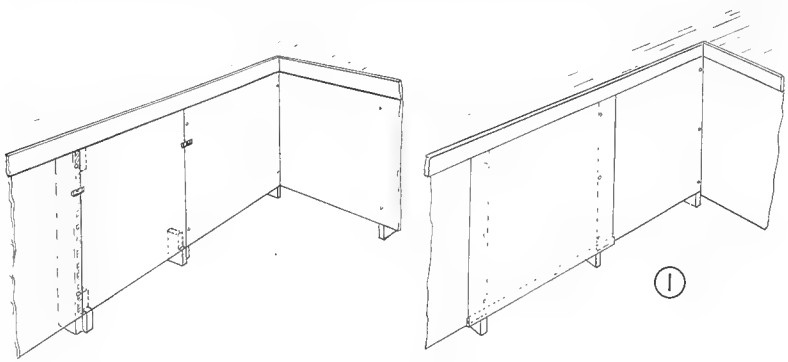
An enormous amount of the annual expenditure on prototype railways is accounted for by the upkeep and maintenance of the right of way. No work is so important in the whole sphere of railway activity as that of the maintenance department, for upon its careful and unwearying vigilance there depends the entire efficiency and safety of the system. The same importance attaches to the upkeep of a miniature layout, and the same pleasure can be found in the task if it is approached with interest and patience. The best of layouts will show poor results and will gradually deteriorate, not to speak of its " letting down " its owner before spectators, if maintenance if neglected. The problem of supervision of tracks and baseboard, as well as of every other feature, begins the moment operation has started, and it continues interminably so long as the railway is run. It is just as well, therefore, for the owner to get the right standpoint and to approach this important business as if it were a pleasurable occupation rather than an irksome " chore " to be scamped or carried out in a haphazard manner. It was interesting to read in a recent description of the Irthing Valley Branch of the Brampton & Carlisle Railway, owned by Mr. Fleetwood Shawe, that in the year 1950, in comparison with some 272 working hours spent in operation, no fewer than 218 working hours were given to maintenance. It is only in this way that really satisfactory performance, such as that railway shows, can be secured. Nor need the point be laboured that this business of upkeep, adjustment, cleaning and light repairing can be just as fascinating as any other branch of railway modelling activity.

The aim of this handbook is to offer to the reader as many helps as possible to carry out this task. In it we shall discuss the importance of cleanliness, the value of a sane measure of system and tidiness, the care of tools and something about their use, the keeping of miniature railway stores, the care of the tracks in order that good running and good power supply may be ensured, the tracing of electrical faults, the supervision of locomotives and their light repairs, the maintaining of efficient rolling stock and lubrication. There is no claim on the part of the writer to originality in all the suggestions that may be given. For over 30 years he has been experimenting and writing on this subject, and it is impossible to state precisely at what points this accumulated experience begins or ceases to rely on the findings of fellow-enthusiasts. Propaganda has a way of becoming part of people, so that imbibed ideas run into one's own make-up; and this is true in the sphere we now enter. In many instances the guidance given and the " wrinkles " offered are deliberately culled from external sources, and on such occasions the source, if it is possible, will be stated.

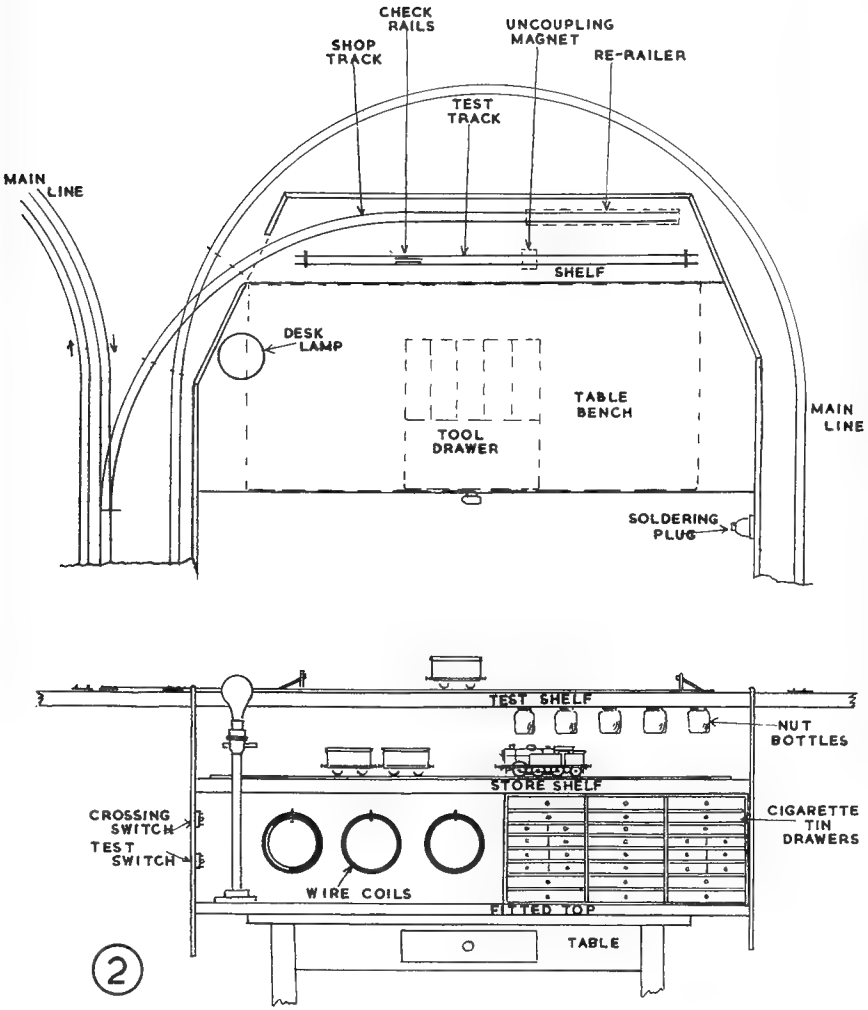
ON TIDINESS IN METHOD

An Orderly Room

Among the enemies of a miniature layout we must not only include such nuisances as dust, damp, variations of temperature and general ageing, but the all-important item of untidiness and slackness on the part of the " authorities." Where this is evident, furthermore, it is only natural to find a similar negligence on the part of the visiting public. Should a cigarette end lie on the floor of the room, it will not be long before others will accumulate. If the lower frontage of the baseboard is uncovered, revealing stacks of untidy stores, unused timber, old sacks and so forth, the entire appearance of the scene above will be spoilt. I am aware that the setting right of all these matters is a process in time and must usually wait until more urgent affairs are given attention; but they should, along with any other disfigurement, be put in order as soon as possible. The aged question of how to screen the front of the baseboard has never yet been adequately answered, and I must confess somewhat shamefacedly that on the West Midland System this work has only been carried out in part. But in Fig. 1 will be found a couple of suggestions that should be useful. It goes without saying that the means of compassing



this job shall be cheap, shall be neat and shall be of such a nature as to permit access and the securing of a measure of light underneath the layout. If these items are granted, it will be possible to store certain goods out of sight, while at the same time the worker will be able to get underneath himself for cleaning and track supervision. In the first suggestion the front has been covered with some form of cheap boarding—Essex board, Tentest, or some of the wallboards will suffice. The majority of these boards are screwed permanently to the uprights, but here and



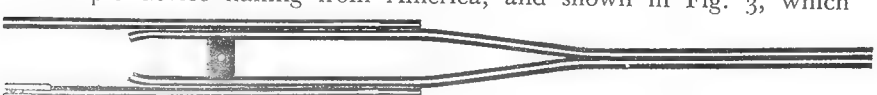
WEST MIDLAND LOCOMOTIVE WORKS

there one of them is given a couple of projecting feet to rest on and is held in place by a pair of turnbuckles. This is the proposed method for the West Midland. In the second suggestion the front is covered with cheap linen-paper window blinds, such as can be had from any ironmongery. They should be all of one width, and they may be pinned to the posts with drawing-pins, access being obtained by having one blind on each side of the room fitted with a lath along its base, hung loosely from the top and arranged to roll up and lay over the tracks at will. If blinds of a dark green or brown shade can be had, so much the better.

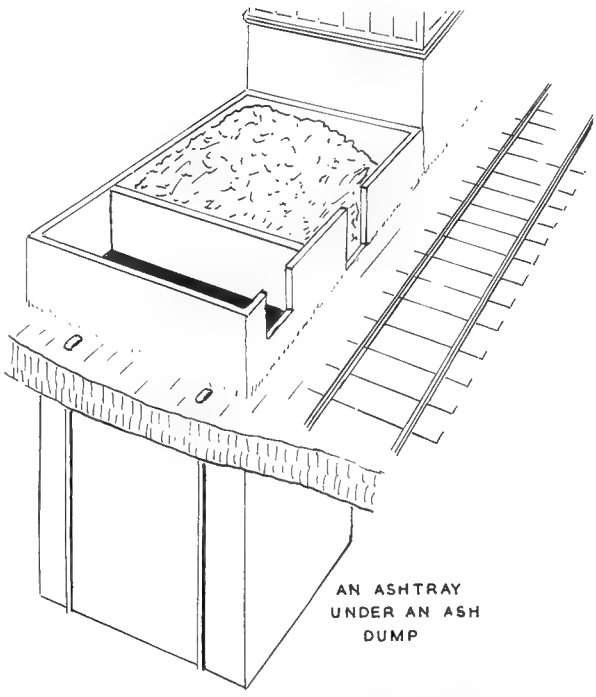
A great amount of tidiness can be secured by the provision of ashtrays for smoking visitors and the workers on the line. These, however, will be obtrusive if they are placed anywhere on the railway itself. A miniature rubbish dump, a locomotive ashplant or an open-top water tank is suggested as suitable. These will be less required for visitors than for the owner himself, should he be a smoker. In a well-equipped room, with linoleum on the floor, nothing looks worse than rubbish underfoot. And while speaking of floor-covering, what about a seat or two, or a stool here and there for the use of spectators? For one thing, this will serve to keep them out of the way of the operator as he may need to move about.

Work and Workbench

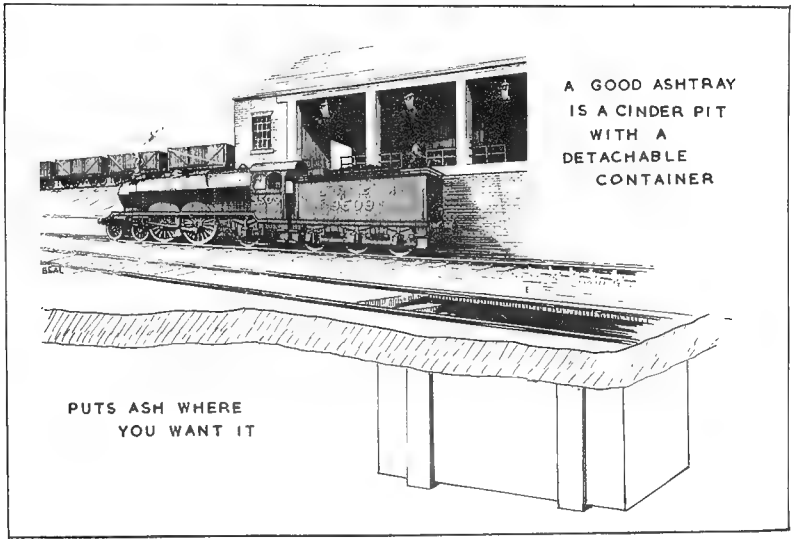
We must hasten on, however, and get to grips with our real theme. Let us begin with the workbench itself. Where do you do your maintenance chores? Do you have a separate yet adjacent workshop, even though it is small and compact, or are you obliged to do everything in the one room? Should the latter be the case, it need cause you no qualms. Any prototype system has its shops, and the designing of a workbench even alongside the railway frontage can be a matter of genuine interest and art. My old friend, Fleetwood Shawe, uses a roll-top desk which was no use for anything else, and there is no better way. In the room where the layout is, this can be so arranged and disguised as to seem a veritable part of the railway. In Fig. 2 there is a drawing of the West Midland shops. The upper diagram shows the plan. It will be noticed that I have secured what I think should always be a feature—the track runs from the main line directly into the shops. Here, I have taken it out of the down main line at Laurenceton Station by a trailing point. It is thus possible to run trains directly into the shops without requiring to lift them and carry them about, and also to despatch trains or locomotives when their repairs are executed. You would be surprised to know how much bad language and how much wear and tear of stock this detail avoids. At the end of the approach track there is a re-railer—a simple device hailing from America, and shown in Fig. 3, which



3 RE-RAILER

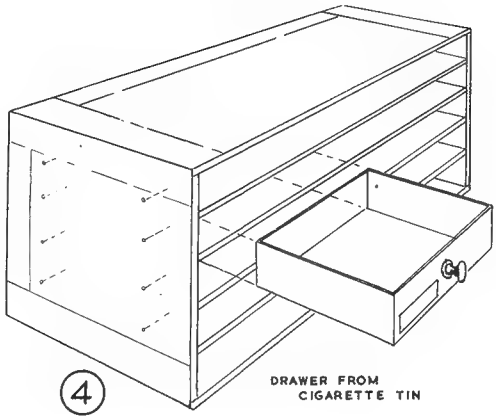


AN ASHTRAY
UNDER AN ASH
DUMP

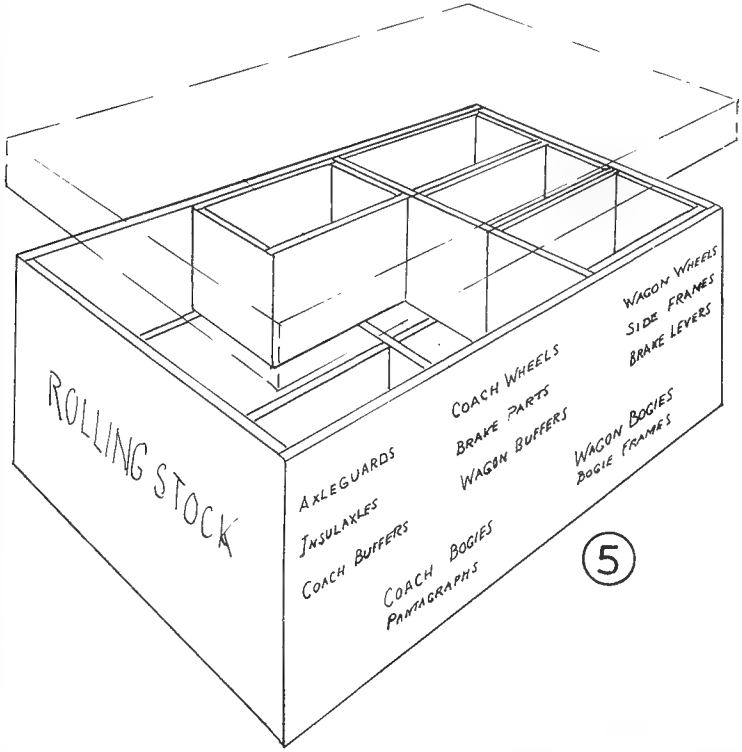


infallibly serves to put any unit on the rails by merely pushing the said unit along. In front of the approach track there is a short test track, which is provided with correctly dimensioned check-rails, an uncoupling magnet and buffer-stops at either end. This track is separately energised and controlled through a d.p.d.t. switch conveniently placed at the side. Since the approach track has to cross another main line to get into the shops, there is also a similar switch to control the crossing, which is two-rail. The bench of the shop is formed from a discarded table which was too small entirely to fill the space allotted to it. It was therefore given a fitted top of Tentest, which goes exactly into the eccentric space provided. This is securely screwed down to the table. Below the shelf carrying the approach track is another shelf with storage tracks; they consist of old three-rail track with tinplate sleepers, being merely used for the standing of stock. On the left there is a pedestal lamp which is portable and can be used anywhere in the 27-ft. by 17-ft. room. On the right there is a bayonet-type holder for the soldering-iron, which is similarly portable. Underneath the upper shelf there is a row of cleaned glass paint pots, the metal tops of which are screwed on the shelf, the bottles being used for small nuts and bolts and other tiny parts. Below the lower shelf we have hooks for hanging coils of fine wire, and, on the right, nests of miniature drawers, each with its knob and label, holding all manner of pins, sprigs, screws and so forth. Of these drawers more will later be said. There is a drawer in the table itself, and this is used for tools. It is a small drawer; but it is astonishing what can be got into it if the same method and tidiness is adopted here as anywhere else. I am all out for partitions in tool containers, and the container itself, whatever it is, should be shallow. In this way, one receptacle takes screwdrivers, another pliers of all types, another gimlets and brads, and a larger one in the front takes a few tools that are too big to go elsewhere. The partitions need give no concern—they are simply formed by long cardboard boxes and their lids laid alongside each other—I use if possible Varney car boxes for this purpose.

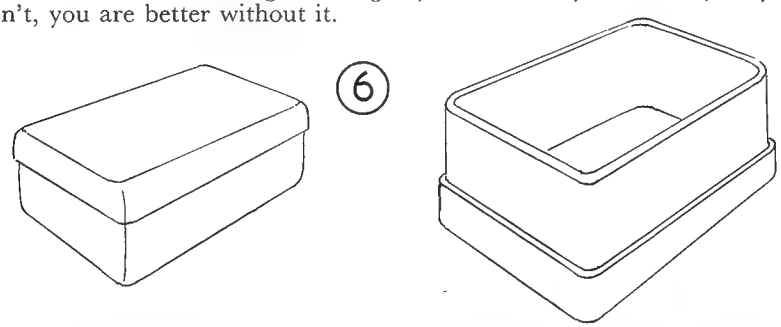
Believe me, it is no waste of time to set about making nests of boxes for the keeping of stores. They can be produced almost without cost. Mainly I use balsa wood for the purpose, $\frac{1}{8}$-in. in thickness and 3-ins. in width. Consult Fig. 4, and the method will be clear. Some years ago a friend presented me with the handsome gift of scores of empty (!) 100-capacity cigarette tins. I laid them aside, having no use for them at the time, but, like all other such laid-asides, they have come into their heritage. Being all alike, when their lids are removed they make perfect drawers. The 50-size tins are exactly half the width of the 100-size, and two of these fill the same space as one of the latter. The balsa casing is made in a few minutes. Two widths are joined together by two strips of adhesive tape, one on each side, and you have a 6-in. wide board. You cut a length of this to suit two tins laid side by side; then you tape on two balsa sides of indefinite length to come up alongside the tins. Next you pin and glue a piece of 6-in. balsa (we are calling this 6-ins., but it will, of



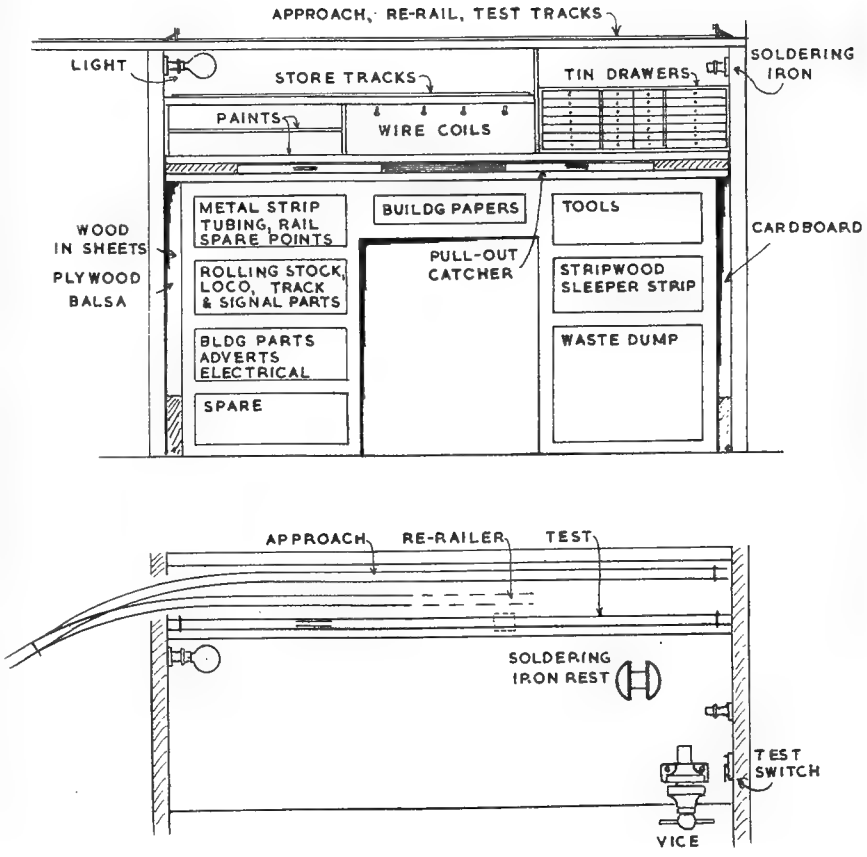
course, be the same width as the length of the tins) on top of the first two tins, the pins going through the turned-up balsa sides. Then you insert two more tins and repeat the process until you are as high as you wish. Then you cut off the sides and tape on the top balsa board. The back can be a piece of thick cardboard also taped on. Your miniature chest of drawers is now complete excepting for the drawer-knobs. For these I use buffers—new ones are not wasted so, if old ones are not to hand. The shank (screwed) is inserted through a hole in the drawer front and attached tightly with a B.A. nut and washer. You cannot have too many of these drawers—they serve to keep lill pins, blanket pins, common pins, gimp pins, panel pins, escutcheon pins, glass-headed pins, screws, washers, track pins, spikes and scores of such articles, each drawer being labelled, and the whole outfit going into practically no space at all. These nests of drawers are good for shelves. But I am also a great believer in nests of boxes to fit into larger drawers, so that at any moment you can lay hands on anything you need. One day my wife had a very lucky find—a whole parcel of bakelite soap dishes, with lids, for threepence apiece. She wisely bought the lot and brought them home to me. On looking at the dishes I found that, by putting the bottom of the dish into the top of it, two receptacles were secured. Taking a dozen of these dishes I made a balsa box exactly to fit the dishes (Fig. 6) and we had 24 receptacles in one box about 6-ins. square. This gave me a further notion, and I set to work and made other small receptacles of balsa and tape, with boxes of uniform size, to house all the stock I own, and this is fairly excessive. These containers will be seen in Fig. 5. Let any enthusiast thus equip himself and he will save half the lifetime of his leisure. Note also the method of indexing the contents of the boxes. If they are to fit into drawers, put the labels, of course, on the top. By glancing at the index you can hit upon the exact receptacle in one



moment. Having made these storage conveniences, of necessity one will need to cultivate a habit which is not easy to learn—that of putting everything in its correct place immediately the stated article comes to hand. It's no use having a storage system unless you *work it*; if you don't, you are better without it.



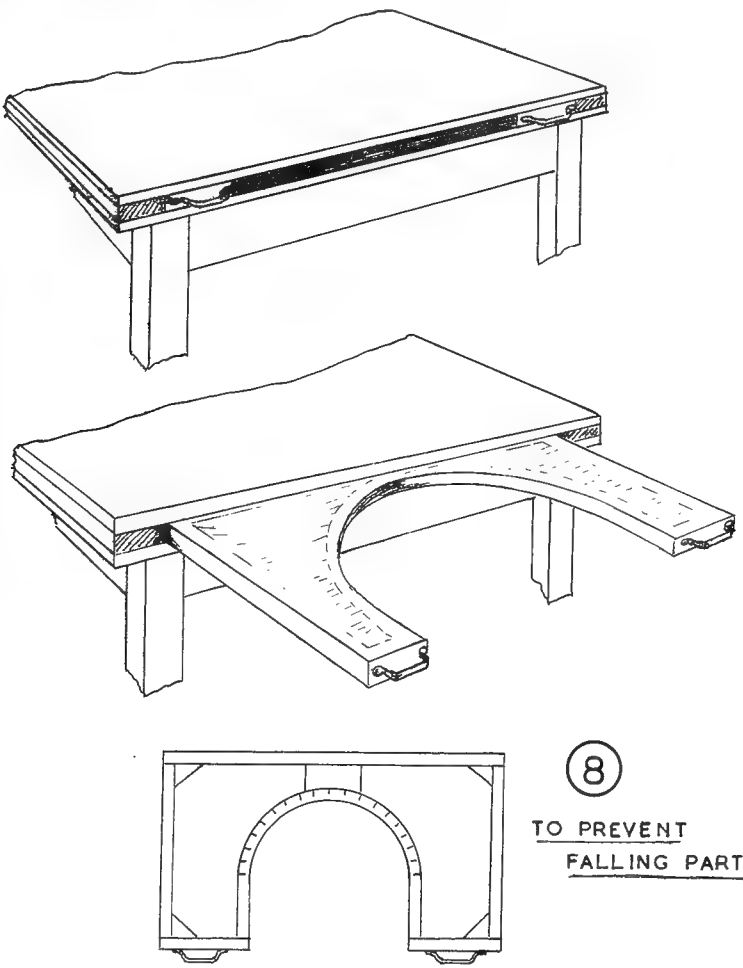
I mentioned a while ago the West Midland shops; but I do not consider this outfit ideal. The ideal one would be much more elaborate and yet much more compact and full. For purposes of suggestion, Fig. 7 will give a notion of this. Here you have a discarded roll-top desk—not



(7)

IDEAL BENCH AND STORE

too large. It may be located in the room with the layout or in a separate adjoining room. Two upright sides of boarding are fitted of the same width as the front-to-back of the desk. The partitions of the desk are removed, and the roller will not be required—it can be kept pushed back. The side boards serve, among other purposes, to bring the height to that of the railway formation, and on the top of these the approach, re-railer, and test tracks are laid. Below, we have much the same arrangement as before. A Tentest top is also fitted to this desk, with a space between it and the desk top. In this space there is inserted what I will term a catching-frame, formed of, let us say, 1-in. square strip-wood in the manner of Fig. 8. This frame is covered on the top with thin felt or

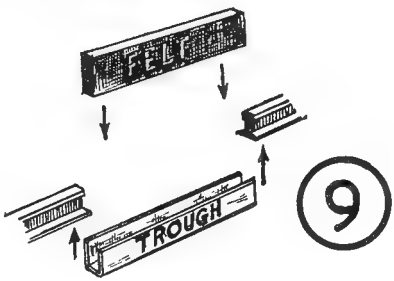


(8)

TO PREVENT FALLING PARTS

stout muslin and has drawing-out handles in front. It fits into the space, and can be pulled out to go closely round the worker when he is handling tiny parts that are easily dropped. Few things are more exasperating than the dropping complaint to a busy man. Use this, and you will never drop another pin. The drawers of the desk are the great advantage here. They can be so arranged with partitions and boxes as to contain within that given space a whole shopful of components. The narrow receptacle at the two sides of the desk will take sheets of cardboard, sheets of fret-wood, balsa and ply. A top-screwed small vice goes on the right. The large bottom drawer, usually to be found in small desks, is the rubbish dump.

While on the subject, a useful item for the test track would be a locomotive wheel-cleaner, of the kind shown in Fig. 9, a *Model Railroader* idea. Each rail has a short piece of brass channel with a felt pad to fit

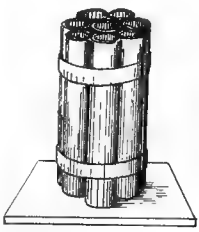


LOCO WHEEL CLEANER

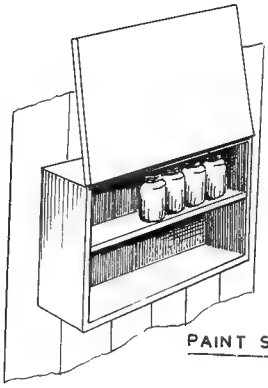
inside. This pad is soaked in tetrachloride and the engine wheels are run over it. This does not serve to clean the leading and trailing truck wheels, of course; but it is an advantage not to have to scrape driving wheels when the two-rail pick-up is attached and can be easily maladjusted.

There are scores of other ideas which are useful from the standpoint of storage and bench work; the worker will pick up many of these himself as his work proceeds. But I have given a few additional ones on which we may touch before leaving the subject. Paper clips are invaluable things to have at hand where there is any sort of glueing to be done, and, failing these, there are certain kinds of spring clothes-pegs which serve a similar end. These are indicated in Fig. 14. In Fig. 11, we have a simple idea for making a cabinet from a common cigar box for the storage of paints. A good scheme for keeping small paint brushes is shown at Fig. 10. Here, a number of small empty glass phials, or even small test-tubes, are strapped together with an india-rubber band and glued to a balsa base. Corks should be made and bored to take the brushes, a tight fit. The phials are kept half full of turpentine and the brushes are kept clean, soft and true to shape. The brushes should hang clear of the bases of the phials.

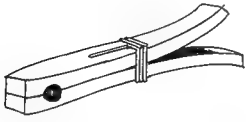
MAINTENANCE

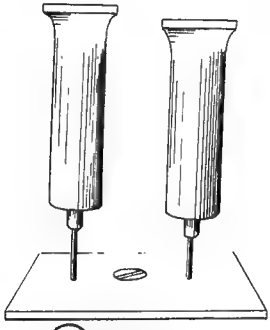


(10) BRUSH RACK

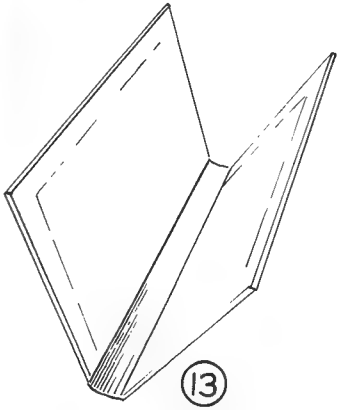


(11) PAINT STORE

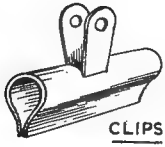




(12) GLUE TUBE HOLDER



(13) FOR BUILDING PAPERS



(14) CLIPS

Fig. 12 gives a good idea for use along with tubes of adhesive. These tubes quickly congeal at the outlet when temporarily laid down, and if a small stand is made of plywood, with two projecting panel pins, and the stand is screwed to the bench in an out-of-the-way place, the tubes can be slotted on the pins to keep them ready for use. The idea in Fig. 13 is that of making a kind of book-cover in which to keep lithographed building sheets. It is very useful if only a few sheets are used; but, where there is a large stock, I would recommend the use of numerous large envelopes, each one labelled, the whole kept in one drawer. Until I myself adopted this method I was never sure how much of any one kind of paper I possessed.

Aside altogether from any form of fitted top of a workbench, it is desirable to have in addition some temporary covering on which to work. Otherwise the top will be spoilt in no time, and will always look untidy. Perhaps the best cover for light work, not including heavy hammering, sawing, chiselling and so forth, would be thin bakelite sheeting, though this is costly. It is impervious to scratches, more or less, and is excellent for cutting on. Failing this, odd pieces of pulpwood or a piece of thick plywood could be used. Perhaps the latter would be the best.

A great deal of tidiness depends on tidy methods of working. I have been in layout rooms where the entire formation of the line was littered more or less permanently with all kinds of junk, so that the layout itself was hardly discernible. Avoid the habit of working on the layout baseboard at all, if possible, and of leaving tools and materials lying about on it. Most people quickly get into the habit, especially if their leisure is limited, of working in haste, using a tool and leaving it lying anywhere, so that when it is wanted even a few minutes afterwards it has to be looked for. This is an enormous waste of time and energy, and can be avoided if the tool-drawer is kept open and the tool dropped in its place when used. Oily and dirty patches on the layout surface are easy caused without due care. Finally, avoid lifting and touching any model whatever, if possible. It is handling models that wears off the paint and surface more than anything else.

Before leaving the workbench there is another useful idea with which we might deal, and that is the possibility of a portable workbench and tool-kit. To possess such a convenient form of equipment might be an advantage to many workers, for if the outfit is portable it can be brought into the house or carried to a neighbouring railway. A correspondent to the *Model Railroader* a couple of years ago gave a useful description of one of these that he had made for himself, and I will take the liberty of including his description as it stands. Mr. K. M. Bunnell writes:

I made my workbench like a suitcase. Its hinged sections are 22½-ins. long, 21½-ins. wide and 1⅞-ins. deep and are divided into cubby-holes for the storage of tools, models and small parts. Here is a detailed description:

A. Hardwood cutting board, 3⅜-ins. × 10-ins, flush with top of

frame.

B. Recess for holding scrap. Felt-covered lid held in place with wing nut.

C. Hinged plywood worktable, recessed $\frac{5}{8}$-in. below frame and even with *B*. Dotted lines show partitions under worktable.

D. Compartment for motor tool, 6-ins. × $9\frac{1}{2}$-ins., felt lined.

E. Compartment for model knife set, 3-ins. × $6\frac{3}{4}$-ins., felt lined.

F. Bin, $2\frac{3}{8}$-ins. × 10-ins., with removable cover. Used for storing decals and small parts.

G. Open bin for holding parts while the bench is set up for working.

H. Box, $3\frac{1}{2}$-ins. × 13-ins., for showcase bulb and reflector. Box is covered with frosted glass and is hinged to throw light down on work.

I and *J*. Drawers, $2\frac{3}{4}$-ins. × 13-ins., for storing spare parts. Drawers are secured by a rod inserted into screw eyes as shown in the sketch.

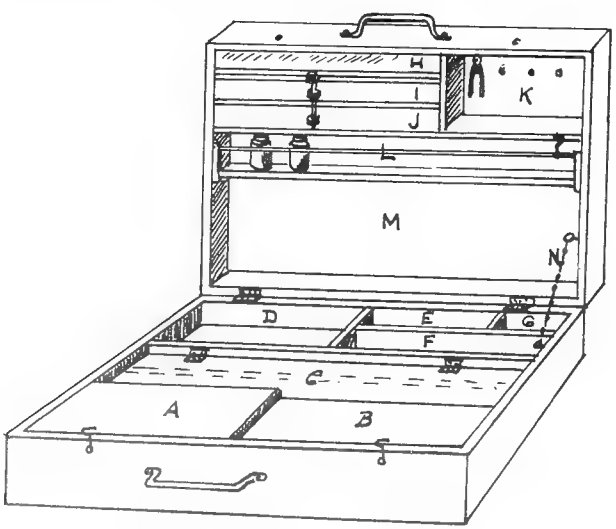
K. Section to hold pliers, cutters and pin-vices. Small hangers hold these tools in place.

L. Swinging rack full width of cover and $3\frac{1}{4}$-ins. high is hinged at one end and fastened with hook and eye at the other. Holds 17 small parts bottles $2\frac{1}{2}$-ins. high and $\frac{1}{2}$-in. in diameter.

M. Space for hanging square, screwdrivers, hammer and other large tools.

N. Removable wire to hold cover open when the workbench is in use.

Handles for carrying and hooks and eyes for locking complete the exterior. The workbench is extremely portable and takes very little room to store.

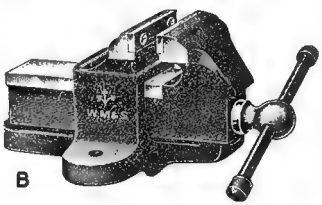


Tools

One of the most important adjuncts to good method is, of course, the possession of good tools and plenty of them. In our naming of some of the tools requisite to good modelling, it is hoped that no reader will imagine that he must begin with the possession of the full kit. Tools, like the necessary stores equipment, must be allowed to accumulate. The outlay in the first instance may be entirely modest, but as time proceeds the stock can be added to. Beginning with a bare minimum, the enthusiast will soon find that he would like more, and the experience he has already obtained will serve as a guide in the further purchases he makes.

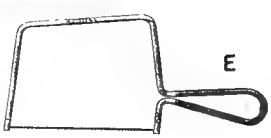
The group of tools in Fig. 15 consists mainly of items such as a joiner would use and are all the products of Marple & Co. Ltd., of Sheffield. The hammer, in the first instance, should not be either too light or too heavy, but of medium weight. A small vice of the type which screws to the bench from the top is invaluable. The mounting shears (c) will be found of the greatest service in cutting strips of cardboard,

A

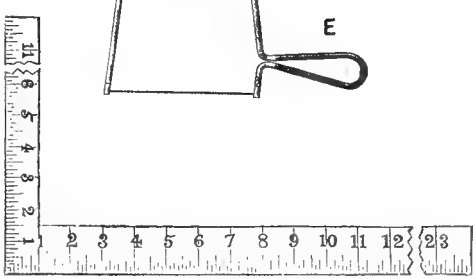

B

C

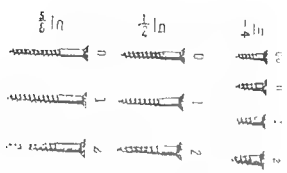
D


E

F



G


H

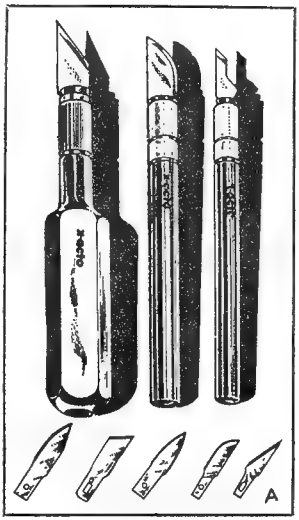
15

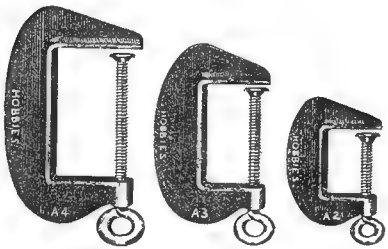
being rather heavier than the ordinary photo-trimmer. The pincers, if a good pair, are indispensable for a thousand uses, but notably for the snipping off of rail-ends and withdrawing of pins. Some form of saw for metal—in fact, one or two if possible—is a "must." A coping saw with fine interchangeable blades, and arranged for both straight and side cutting, is a veritable blessing to the workshop. It will cut either strip-wood or metal. A brad (f) is a tool I personally cannot do without, and a steel square with inches on one leg and centimetres on the other is absolutely necessary for all knife-cutting chores. To use any other kind of rule will mean the cutting of the guide and the absence of a genuinely straight edge.

Speaking of knife-cutting brings to mind the need of a sound tool for the cutting of thin wood and card. Nothing could surpass the X-Acto series of cutters for this work. The blades are razor-sharp and are interchangeable; they will be in great demand for cutting building papers, balsa wood, window apertures and so forth. Clamps are also repeatedly required for the holding of glued work, and those shown are a Hobbies product. The remainder of the ordinary tools shown in Fig. 16 are to be had from Hamblings or Bonds. The screwdriver shown at (c) is a single unit, but I would strongly recommend a boxed set of half a dozen, ranging in size from about $\frac{1}{8}$-in. down to the required calibre for jeweller's screws. The scraper sets (e) come into service for the cleaning off of rough soldering, and are the first things wanted after the soldering-iron in locomotive work. Tap wrenches I would not call a first essential, but they will be wanted immediately the making of threads is demanded. Get a set with a tapered reamer for making larger a drilled hole in thin metal. An electric soldering-iron is the most useful tool there is, and no worker could proceed without one. The best kind has a very small and light bit, but if interchangeable bits are bought, so much the better. A pair of small tweezers is excellent for picking up minute parts, though a cotter-pin can be out-sprung and given fine points to serve the purpose. Of pliers, a varied assortment will be needed—long-nosed, diagonal cutting, heavy linemen's for cutting thick wire, and, if at all possible, a pair of pincer-nosed pliers for nipping fishplates tight, the smaller the better. A pin-vice is also extremely useful. Of saws, beyond those already named, a good tenon saw and a keyhole saw should fill the bill.

Few tools are more necessary than a full set of needle files, one rat-tailed, one three-sided, one flat and very thin (for filling out frogs) and one square. A hand-drill and drill-set will also be necessary. Get a pair of good large scissors and avoid carrying off the household pair! A set of spring paper-clips (Fig. 14) has already been mentioned. A small spirit-level for track work will not come amiss. Keep your tools on the small side as much as you can; they take up less space, and most of the work you will do will be light work.

One of the happiest of my own possessions in the workshop is a very fine magnifying lens of tremendous power, having a heavy stand and a lens about 4-ins. in diameter. I find this absolutely indispensable to a hundred purposes; for all fine work that would otherwise strain the

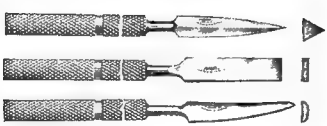

A


HOBBS
A4
HOBBS
A3
HOBBS
A2

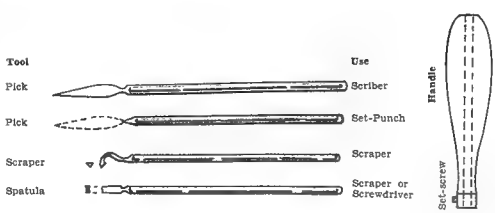
B

C

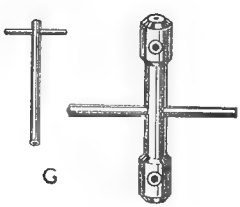
D



E


Tool
Use
Pick
Scriber
Pick
Set-Punch
Scraper
Scraper
Spatula
Scraper or Screwdriver
Handle
Set-screw

F

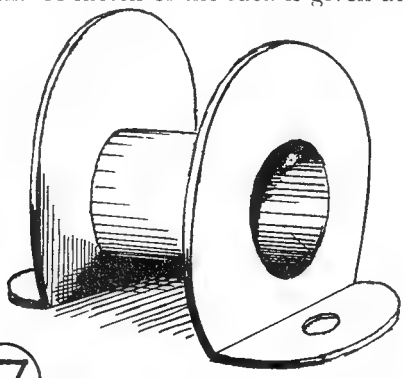


G

(16)

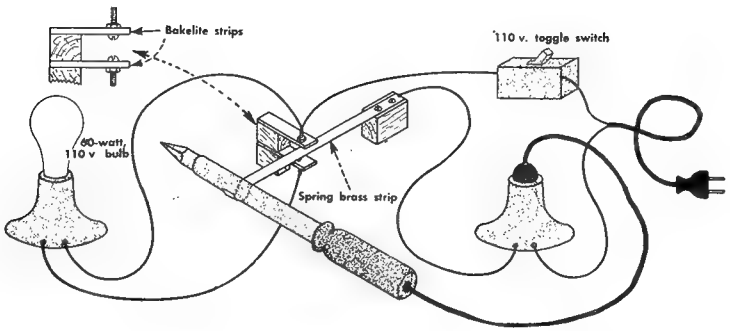
eyes, for lettering wagons and engines and such like. It is well worth while to buy a good one. This instrument makes the task of fitting valve-gear enormously easier.

The mention of a soldering-iron brings to mind the work of soldering, of which many workers of the amateur kind are sore afraid. There is really nothing to fear about it. With an electric iron soldering is a pleasure. The important items about it are, first, to clean the work, second, to use a bit equal to heating thoroughly the joint, and, third, to use good solder and flux. The best solder is resin-centred in coils, and the cleanest flux is Baker's Fluid, though the finished joint should be well cleaned off to avoid corrosion later. If you do not clean off the fluid it will later penetrate even a painted surface and show up with a white crust. But a touch of tetrachloride on a cloth will thoroughly clean it away if this is done immediately. The use of a blow-torch is a handy accomplishment, and one can be had from Hamblings or Bonds. An old toothbrush, wetted in water, is excellent for brushing off the excess solder when a torch is used. It is good to have a wall-holder for your soldering-iron by the side of your bench, and I myself prefer the bayonet type because I can plug in the iron to any of the light-points as well. A rest on which to place your iron while not in use is also essential. An excellent expedient for this purpose is to use a disused metal spool, with each of its sides turned outwards to form flanges which can be screwed to the bench. A sketch of the idea is given at Fig. 17.



17 REST FOR SOLDERING IRON

An extraordinarily good idea was described in the *Model Railroader* recently for a heat-control device for an electric soldering-iron. It was put forward by Mr. R. G. Mayer and his drawing is reproduced in Fig. 18. The idea is that of putting the iron in series with a light bulb. Enough current flows to the iron to keep it hot, but not enough to cause overheating and to char the tip. When the iron is picked up for use, the bulb is cut out and full heating is cut in.



MR MAYOR'S IRON CONTROL

18

There are numerous good expedients for the holding of small parts while soldering. One is to stick them, if pointed, into a halved potato. A still handier procedure is to use a lump of plasticine. Thus, the four sides of a wagon can be set into a lump of the plastic while having their corners spot-soldered. Small brake and hopper-control wheels can be held in place on their rods by this means while being soldered. The plasticine is easily removed when the work is finished.

While we are engaged with the subject of soldering, it may be mentioned that an acceptable form of iron is the small pencil type which can now be had and which operates on anything from 12 to 24 volts. Its cost is low, and it can be heated by merely clipping its leads to the track. This type of iron is, of course, no use for heavy work, but it is most convenient for track-bonding and similar light duties, and it becomes hot in a few seconds.

Mention must also be made of the usefulness of discarded dentists' instruments—drills, scrapers, picks and spatulas. These can usually be had from a friendly practitioner, and their purposes are shown in Fig. 16 (f).

As a matter of fact, though anyone is liable to think he can use a file, there is much more skill in the working of that tool than in the whole realm of soldering. Filing is a knack which is only acquired and cannot be taught in words. Two important hints would be, first, the working of the file, quite level, only in the outward direction and the refraining from drawing it backwards over the work, and, second, the maintaining of a regular and absolutely balanced body-movement on the part of the operator. There are few who can file correctly, and few who really know how to file at all. Files can be cleaned when they become clogged with metal filings by rubbing the file crosswise with a piece of brass or alu-

minium, and if this fails a wire brush may be successful.

Drills and taps require lubricants—oil for brass or mild steel, turpentine for aluminium or lead, or for copper, and tallow for cast iron.

I am purposely refraining from the discussion of lathes and lathe work; the subject is too large for this handbook and its writer is no expert with regard to it. If you are proposing to enjoy the luxury of a lathe, make it a point to buy a good one, get a book dealing with lathe work, and, when you have become expert in the use of your machine, your workshop will be complete. In this writing we are dealing with light equipment such as can be kept in a very small workshop.

Aside altogether from tools, there are numerous adjuncts to the " works " which will be required. Screws for wood and metal work come under this head. Fig. 15 (h) gives the full sizes of 10 grades of wood screw such as modellers will want to use. They can mostly be had with either round or flat heads and either in brass or iron. B.A. bolts and nuts in all their smaller sizes will be necessary, and it is recommended that a good stock, even if a modest one, should always be kept. Various kinds of pins are indispensable, beginning with lill pins of a minute size, which come in for hundreds of jobs, and going on past household pins to blanket pins, which are household pins magnified to about 3-ins. in length. These are invaluable. Gimp pins of all sizes should be kept in regular and unexhausted stock, a handy size being about $\frac{1}{4}$-in. in length. For scenic work, track work and all manner of tasks these are always being called into use. Glass-headed pins are also handy, especially to serve as markers for ramps, for section limits, for feeders to the track. They can be had with heads in all colours. Long, thin, brass flat-headed pins of the escutcheon type are also useful.

The worker will quickly adopt his favourite glues and adhesives, of which there are today endless varieties on the market. For a common glue, I myself use Certofix or Seccotine; I never use cellulose glues unless for celluloid work, neither do I use cellulose paints. I object for one thing to their " pear-drop " scent, and for another to their habit of perishing in their containers. You cannot go wrong with Seccotine, and you can use it on the largest sheets of building paper without the slightest warping or wrinkling if you go about the work in the right way. On a large area, spread the glue after administering it in plentiful blobs, with a piece of cardboard bent in the fingers, and work reasonably quickly. For small work, use the little finger. Copydex and No-So are amazing adhesives. They will stick cloth to cardboard, card to wood, cloth to cloth, leather to wood, and they will set firm while the work is held in the fingers. These two adhesives are most admirably suited to attaching a cloth covering to a tunnel face behind the wing walls, and for joining two lengths of scenic cloth with an invisible seam. They are very clean to handle and can instantly be rubbed off the fingers or any surface. A good wrinkle when using Certofix or other tube glue is to use a blanket pin or sharpened matchstick for applying the glue to small objects.

MAINTENANCE

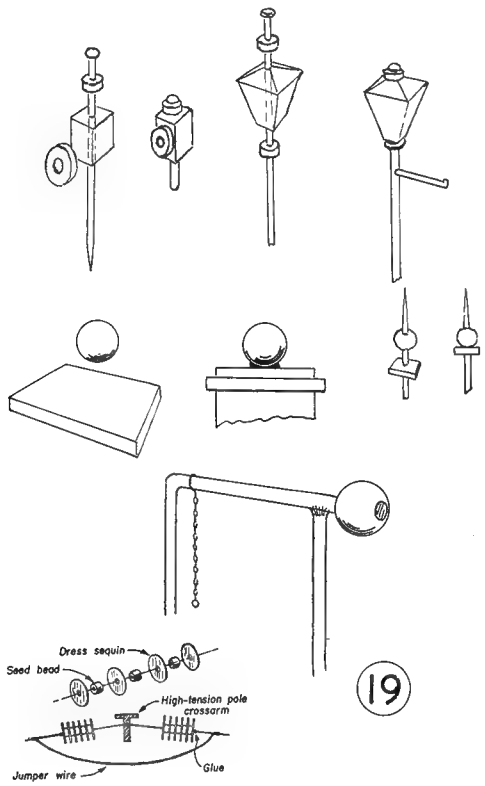
Stores and Storekeeping

It is a sound plan to keep a good all-round stock of everything that is likely to be required in the workshop by way of materials and to keep a list on which can be jotted down scarce items as they occur. I would repeat, however, that it is not a matter of buying in at the outset a huge stock of stores, but rather one of carefully keeping everything that may be useful from all manner of sources, and of allowing stocks to accumulate throughout the years. It is here that there emerges the importance of properly storing materials in the manner already indicated —otherwise the whole place will be cluttered up with unclassified and heterogeneous articles.

So we will assume that the worker is already in possession of a " stores department " in the form of the balsa cabinets we have described, each one labelled for its main contents. Here is a list of them:

Coach and Wagon Parts	Locomotive Parts
Track Parts	Building Parts
Oddments in Wood	Oddments in Metal
Building Papers	Pictures
Advertisements and Signs	Electrical Fittings
Screws and Pins	Signal Parts

In the Coach and Wagon Parts cabinet the aim should be to accumulate spare wheels, bogie frames, side frames, axleguards, buffers, couplings, headstocks, brake parts, strapping and corner angle, ladder strip, vacuum tanks, insulaxles. In the box for Locomotive Parts we want buffers, screw couplings, headstocks, domes, chimneys, safety valves, vacuum pumps, coupling rods, cylinders, valve gear details, wheels, armatures, gears, commutators, brushes, handrail knobs, boiler fronts, tender-front castings, minute screws in a corked phial, and any other items related to engine work. The Track Parts should include all types of chairs, sleepers, sleeper clips as adopted on the system, spare frogs, spikes, a coil of sleeper strip, spare point blades, angle cranks, point levels, ground signals and a track gauge. If you possess a wheel-gauge for spacing wheels, keep it always in a definite place in the Rolling Stock box. Otherwise it will always be missing when you most want it. Building Parts include windows, steps and stairs, chimney pots, chimney stacks (left-overs), doors of all kinds, mouldings of every sort, downpipes, corrugated iron, garden fittings, gates, dormers. By the way, excellent chimney pots for oo-Gauge can be made by using the small asbestos beads which are used in insulating soldering irons. Whenever you discard a spoilt iron, keep these precious items. Your Wood Oddments will comprise all waste ends of wood angle (excellent hopper wagon undergates are made therefrom), small round spools, short dowel ends, Hobbies ornamental cappings, wooden buttons, fretwood diamonds and other items good for bridge pier copings, bits of Hobbies mouldings and such like. Oddments in Metal are shoe-eyes, paper clips, cart and carriage wheels, snap-fasteners of all sizes (precious indeed are these!), collar-studs from the laundry, outsize brake wheels, signal bases, finials, etc., odd bolts and nuts too large for



BEADS ARE USEFUL IN MANY SHAPES

ordinary usage, metal beads and balls, discs, tentmakers' eyes for clock faces, small clock gears and springs, and all the rest. I have already described the contents of the Adverts box; the box for Electrical Fittings is highly important, containing as it does all manner of switches and their parts, small bulbs, insulation, point machines, odd coils, small motors, elements, bell-pushes, and everything pertaining to the switchboard. Screws and Pins have their own cabinet also, while Building Papers and Pictures (for scenery details) have their filing folios.

The art of accumulation is really more complex than it sounds. It consists mainly of an instinct which knows at once anything that even *might* be useful, and knows also how to discard anything which obviously never will be. It does not mean the mere piling up of junk; and that is why one is rather amused on hearing people talk about their "junk box." As if any single receptacle could be capable of containing and

classifying the scores upon scores of nicknacks which form the contents of a Stores Department! The art of accumulating material is a lifetime art, but an art worth the cultivating.

If you keep a special cabinet for Signal Parts, this should contain also the dwarf signals and any other such details we have related to the Track box, as well as semaphores, light springs, finials, bases, spare posts, signal solenoids, balance weights, signal ladder and all items of that kind. Strip-wood, as already suggested, has its own drawer with suitable partitions. The range should work up from $\frac{1}{16}$-in. square section to about $\frac{3}{4}$-in. Dowelling, including a few medical applicators, might go in the same place.

Paints will be found to accumulate like everything else, but should, if possible, be bought in small bottles or tins by reason of deterioration through time. Rocket Precision engine paints are good as a rule, though for a really velvet-surfaced black, without any shine, there is nothing to equal art metal black, obtainable in pint-size tins. No larger tin should be bought. Oil colours should all be flat-drying, and ought continually to be examined, and, if necessary, thinned and stirred, care being taken to tighten the lids. For scenic work many people use poster colours and water tints like Winsor & Newton's or Reeves'. These are good, though for the type of scenic construction the writer adopts, oils serve to stiffen the cloth work better. For lettering vehicles, however, water colours are best, and can be applied with a mapping pen, being afterwards bound with a coat of fixative. All paint brushes should be washed out immediately after use. Along with paint there might be classified green and brown flox, which should be kept in store. Mention must also be made of creosote—one of the most useful of all such commodities. It costs almost nothing, even in these times; and it gives a splendid finish to such models as bridges, coal chutes, level crossing roadways and any other item requiring to appear weathered. For the insides of wagons there is nothing like it. The only precaution necessary is to say that it must be carefully used on soft woods, since it has a way of spreading itself on to adjoining woodwork. A most useful commodity also is ballast—whether used on the track or not—kept in the form of graded gravel siftings. For scenic work I find it invaluable.

Cleaning

We are discussing method and tidiness, under which heading we may well include the work of cleaning the layout. This is a process which as a feature of maintenance must be regularly sustained. A general dusting and cleaning-up well repays the effort and imparts an attractive freshness all round. A good supply of dusters and dust brushes should be kept, a paperhangers' smoothing brush being of great service. Yet, while brush-dusting is useful, nothing can take the place of the duster for removing dust on buildings and the like.

For cleaning up the track-formation surface there is nothing to be compared to the Hoover Dustette, or some similar machine, especially where the two-rail system is in operation. With this instrument one can

get right down to the top of the rail and completely suck off every atom of dirt. To see the mark of cleanliness left in the wake of a Dustette on a railway surface is an eye-opener. It is useful also in that it will pick up light pins that may have dropped between the rails.

An enormous lot has been written on the subject of track-cleaning. All operators know that electrified rails have a way of accumulating in a very short time a gummy coating of dirt which sometimes gets so thick as to cause derailments. It certainly causes poor current supply if it occurs on engine drivers. For the periodic removal of this coating many owners have designed special rail-cleaning vehicles. Some of these are fitted with heavy weights and a pad underneath soaked with cleansing fluid, and by running this vehicle over the rails the latter are cleaned off. This method may be all right, but I always wonder when I read about such vehicles how it is possible to run them if the tracks are really as bad as that. It is not generally known, but it is an established fact that the best way to keep the tracks glisteningly clean at all times, so that they will never require any other form of cleansing, is simply by continually running the traffic. I will guarantee that a railway used for a solid hour every day without intermission will rarely require its tracks cleaning. Of course, there are occasions such as holiday periods when this cannot be done, and unquestionably after these periods cleaning is an essential. My own method, though perhaps unorthodox, is to go round the tracks on my return with an artists' sandpaper block. In over 30 years I have never known this method to cause the slightest damage, and it certainly takes off the dirt. I believe that tetrachloride is also good, but I have never used it. I believe that Mr. Fleetwood Shawe, whose tracks are the cleanest I have ever seen, has never used any other method than that of running trains.

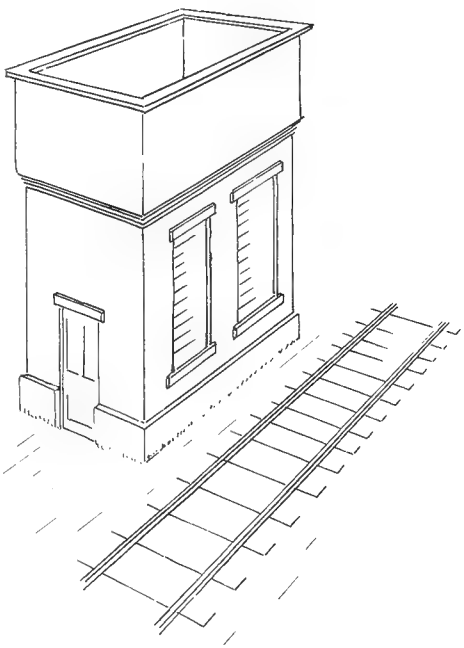
During the holiday periods mentioned, it would be an excellent plan to cover the layout, if it is not too extensive and complicated, with dust cloths. The work would be well worth while, for protection would also be given to the buildings and structures as well.

An important matter is that of preventing condensation on skylights if there are any of these, and the cure is not easy. The constant dripping of a skylight will cause great damage to things if it is allowed to proceed. The only method I know is to make tinplate troughs, to suspend them along the skylight base, and periodically to lift them out and clean them. This also may seem to be a wearisome chore, but it will repay the effort.

In setting about a periodic cleaning, always begin at the ceiling and work downwards, finishing on the floor. The reason for this suggestion is very obvious. And it is well to observe a definite routine in the cleaning after the start has been made. Begin with the ceiling and walls, first having lifted off all movables; then sandpaper the track, then vacuum the baseboard. Finally dust all the movables and structures, replacing the former, using a clean duster for the buildings and larger items and a soft dust brush for small models and awkward corners. Finally, sweep the floor without causing any dust to rise.

MAINTENANCE

Needless to remark, every layout should have a rubbish receptacle in the form of a basket or box, which should be kept somewhere out of sight but handy of access.



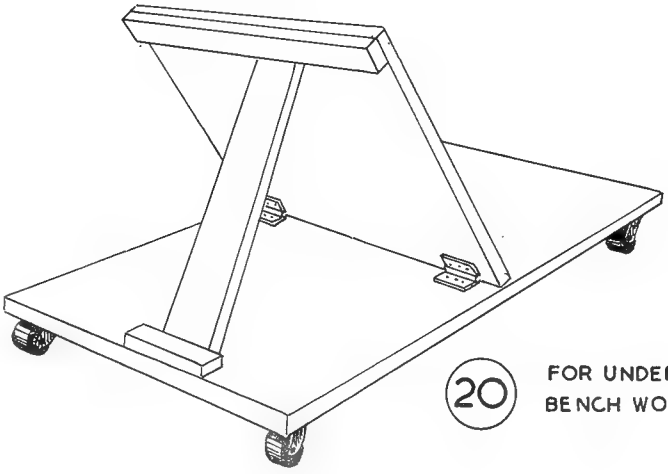
MUSTARD TIN
WATER TANK SERVES
A PIPE SMOKER

PROVIDING AND SUSTAINING POWER

A considerable amount of maintenance work attaches to the matter of sustaining the supply of electricity to the trains, and in our sphere this work will divide itself into several departments, such as the treatment of the tracks and their sectionalisation, the tracing of electrical faults where these occur, and the due attention to be given to batteries or power-sources.

Trackwork for Power Supply

It is not proposed to deal with the various problems of wiring or of switchboard arrangements in any measure of detail, since these subjects belong rather to constructional than to maintenance work. It is rather with the upkeep and improvement of these items that we are here concerned. One of the first requirements, for example, where access must repeatedly be had to the underside of a baseboard—provided that already the structure has been so arranged as to permit this, the cables being tidily hooked up and there being plenty of headroom—is some pains-saving method of getting at the wires and other fixtures. One American worker has devised the simple but useful contrivance shown in Fig. 20. This consists of a trolley having a hinged back which can be



20 FOR UNDER-BENCH WORK

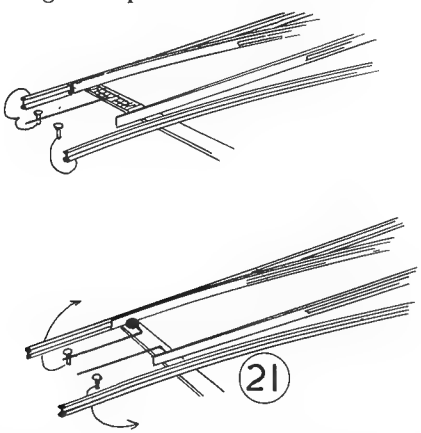
let down flat for storage purposes, and can also be used as a back-rest, the trolley itself being fitted with common bed casters. Where the layout is large this is a most handy idea.

A vast amount of labour on track will be saved if the newest methods of track-laying are in the first instance adopted; and here we will slightly trespass beyond our self-imposed bounds. The old notion of fixing down the sleepers tightly to the trackbed is rapidly becoming dated in the small gauges, for it leads inevitably to distortion through shrinkage and expansion. The new method is to solder the rail joints and to make up as much track as possible in one integral piece, the whole being arranged to lie snugly but loosely on some form of rubberised or felt ballast-bed. A few pins are inserted here and there—notably at points and at two-rail gaps—but these are not driven right home, being allowed to project about $\frac{1}{16}$-in. while at the same time clearing the wheels. In a very short time it will be found that the weight of the trains will press down the track close to the roadbed, and the loose track under the weight of the trains will be much less liable to cause derailments than the unevenness which unavoidably follows tight spiking. It is really a matter of allowing the trains themselves to "iron out" the track as they pass over it, and no part of the track can therefore possibly be fixed lower than another. The underbase must, of course, be reasonably level, though even here it is only a matter of supporting the rails snugly under the wheels. The enormous advantage of the track, also, is that it is absolutely silent—all track noise is caused by the echoes resounding through the under supports to which the rails are nailed down. On the writer's layout, the tracks running through the garage were all laid in this way, and the place itself is endlessly coated with dust, dirt and grime, and is subject to damp and extremes of cold and heat. This method was actually adopted as a temporary measure two years ago, and to look at it then was to be convinced that nothing could ever run over it. But it remains still in its early form, and no such thing as a derailment has ever occurred unless caused by a definite obstruction.

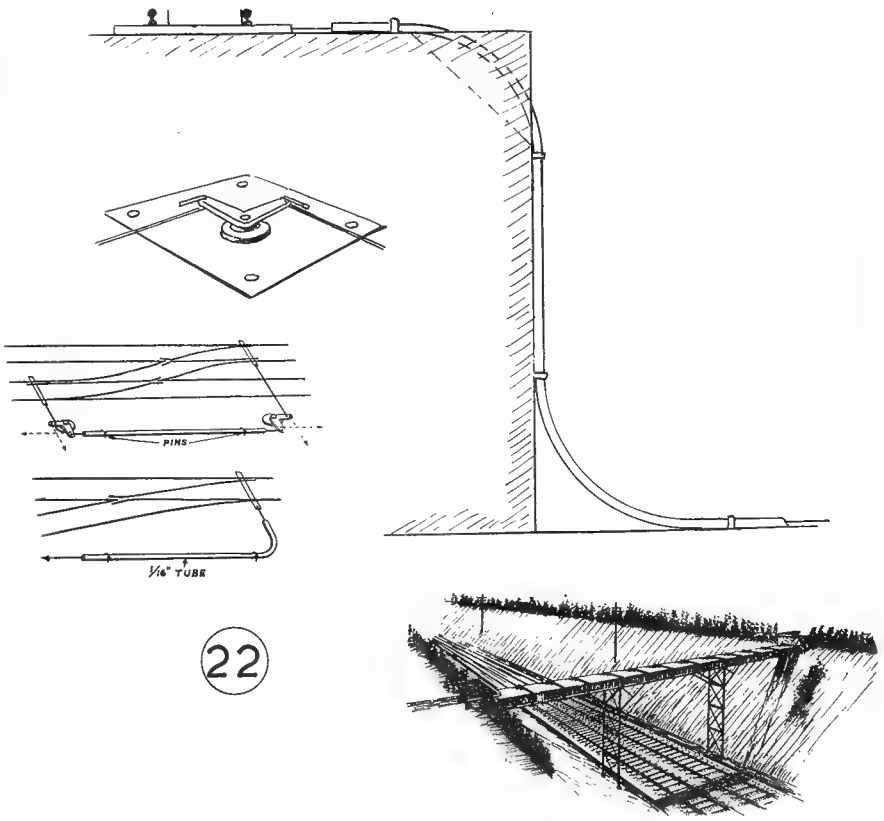
If the track is severely spiked down, then the baseboard must be continually watched for warpages, and occasional packing with thin card will be necessary when warping does occur. With this older method, too, if the track is laid in summer the gaps at fishplates should be very slight; and if laid in winter they should be liberal. The track should at all times be watched in case it shows signs of warping, and such warping must immediately be attended to.

It is also of great importance, where the points themselves are relied on for the directing of current and the supply of electricity to any given track, to make sure that the electrical connection between the blade and the stock-rail is satisfactory. Failure here may be due to many things. The entire point may have been badly constructed from the first; the contact may have been destroyed by warping; most probably there may be dirt or corrosion on the contacting surfaces; or, if a point-machine is used, this may have faulty tension. The best method of

making sure of this contact permanently is shown in Fig. 21. A crossbar is soldered to the rails between the points, or is attached by insulated means if the blades are to be separated. This bar engages small contacts as it is thrown with the point to one side or the other. If a troublesome point is treated in this manner it should give no further inconvenience, and, of course, the idea is simply that of a substitute for the old type of section-switch working off a point.



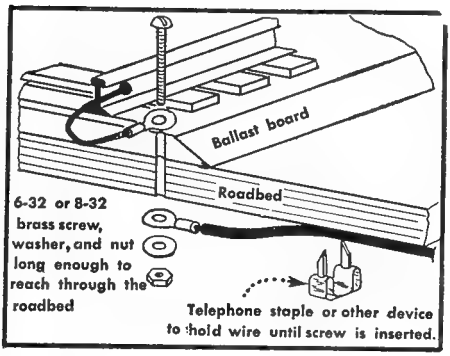
While dealing with the satisfactory operation of points, it may be as well to touch briefly on the matter of point operation. In the smallest scale (oo-Gauge) I recommend the use of fine metal tube with a moving core of wire. I believe that I was the originator of this idea, and it has always astonished me that it has not been most enthusiastically taken up, though for a long time I know that it was difficult to obtain the tube. The type recommended is $\frac{1}{16}$-in. outside measurement, and the wire should be fine piano wire. In Fig. 22 I have given a number of new ideas for the application of this system. As will be seen, the tubing can be carried anywhere below or above the baseboard. It will take a quite sharp curve down to about 1-in. radius, if it is bent with the wire in it. Where long lengths of the tubing run along the surface, they can be soldered side by side and made to appear exactly like point-rodding. A word of caution is needed as to the fitting and holding down of angle-cranks, especially where the baseboard is of pulpwood or soft material. The infallible secret is simply to solder the base of the crank to a small square of tinplate, to make four holes in this plate and then to *screw* it down with quite small screws aided by a little glue on the underside of the plate. That angle-crank will stand anything, and the sketch shows the idea. Be careful in soldering the crank to the plate lest you allow the angle pivot to seize. If you want to carry a tube across a cutting, or even several such tubes, run them side by side through an imitation conduit—a good use for a novel feature. On the West Midland there are simply scores of tube-operated points which give the utmost satisfaction.

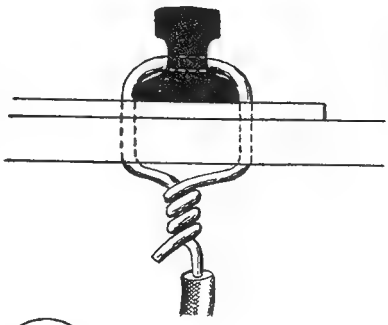


22

The joining of feeders to the tracks is also important if good contact is desired. Fig. 23 shows two methods, one of which was devised by Mr. Linn Westcott, the advantage of which is that it can be disconnected and reconnected at will. The other is very simple and has the advantage of not coming adrift. Soldering is very good, of course, but if acid is used it is quite common for such joints to break and give trouble.

Closely connected to feeding is the matter of bonding. It cannot be too strongly urged that at the very outset when the track is laid it should be bonded at every joint. Fishplates are absolutely useless for the carrying of current, especially the tiny ones now supplied with most commercial track. Bonding (Fig. 24) can be done by soldering short lengths of bare wire either to the rail-ends themselves or to the chairs of the end sleepers where soldered track is used. Alternatively, as already suggested, the whole of a large section of track formation may be soldered in one integral piece if it is not going to be rigidly fixed down.

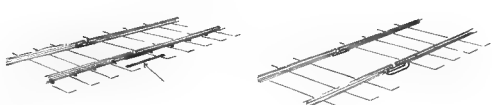

Ballast board
Roadbed
6-32 or 8-32 brass screw, washer, and nut long enough to reach through the roadbed
Telephone staple or other device to hold wire until screw is inserted.



23

Tracing Electrical Faults

No matter whether the system used is two-rail, three-rail or stud-contact there will occasionally occur one or another of those annoying power-supply breakdowns which are more or less inevitable. Sometimes it is a broken wire, sometimes a short-circuit, sometimes a failure of power from the source. The railway owner can save himself a fabulous amount of trouble and irritation if he will label his wires beneath the baseboard, and if he will adopt some form of switchboard control which includes the breaking up of the layout into sections, and if he will keep a well-drawn chart of his own electrical arrangements. It is astonishing how rapidly one can forget completely the wiring of one's own layout, and how one can be completely at sea for half a day until the scheme is worked over and found out. Keep a chart, and you will always know. Another aid is to mark the places where your feeders occur on the track-side, and also to mark the ends of your sections on the layout. Schemes for doing so are shown in Figs. 25 and 26. For feeders, use red and black glass-headed toilet pins; for section-joints (or should I say gaps?) you can use a small white block of wood with the pin through it and the section numbers painted on.



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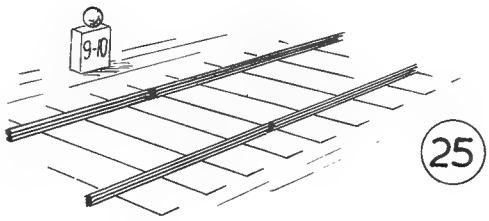
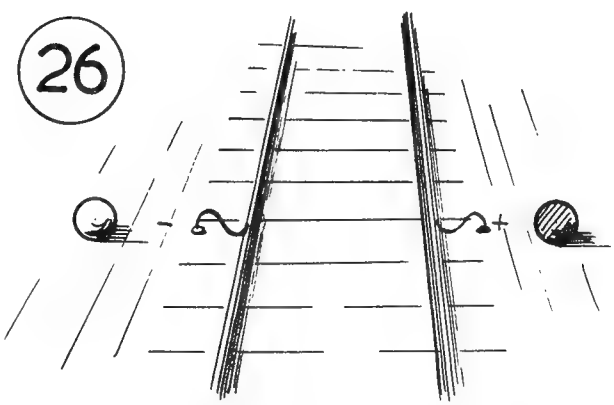
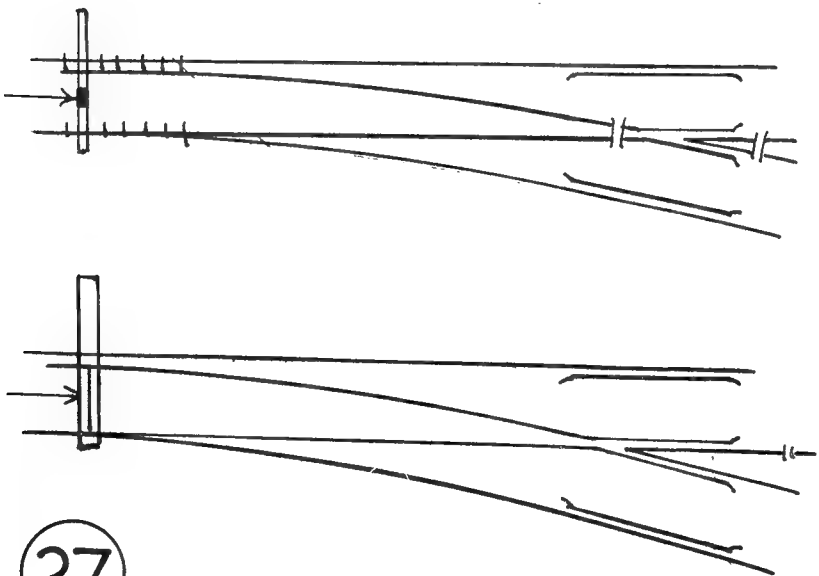


SHORT-CIRCUITS

The more common causes of short-circuits can be gathered into long tables which make them appear very formidable, but they are not so formidable as they appear, for the victim can remember to his comfort that of all the listed possible causes, his own will only be one. If on an engine, it may be the insulated brush that has grounded, wires from collectors touching each other, a bogie may have been turned so that the

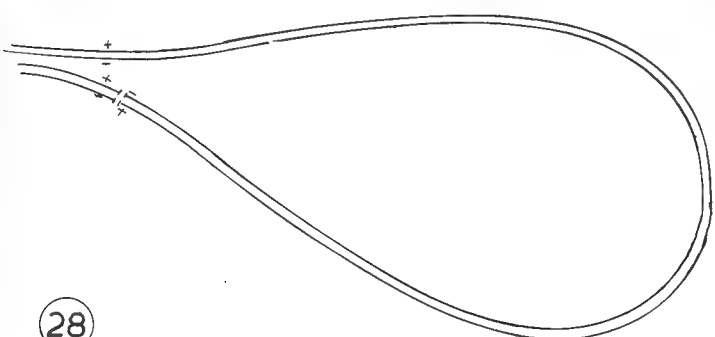


insulated wheels are on the wrong side, the insulation on a wheel rim may have perished, a bogie or truck may be contacting a frame, or the motor armature may be stuck. If the trouble is not on the engine, it may be that a gap in the rails has closed through expansion, the insulation on an insulated axle may have given out, a track spike may be piercing through a roadbed and contacting a bridge truss, some gap or another may have been wrongly placed, the wire operating a point may somewhere be contacting a rail (a very common trouble that is sometimes elusive), a feeder may be connected to the wrong side of a track, or some metal object may be lying across a track. Another frequent cause of



27

trouble easily remedied is when the wheels of a vehicle or engine touch the point blades in crossing a turnout. In Fig. 29 the cure is given. It is sometimes only too easy to connect positive or negative feeders to the wrong rail on a turning loop, and great care must be shown lest this occur in laying new track. I was once the helpless victim of a persistent and undiscoverable short, which proved to have arisen from my having fitted



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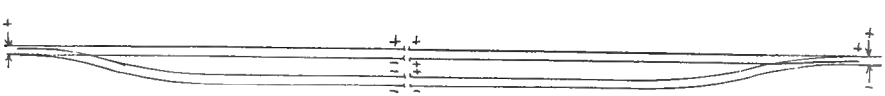
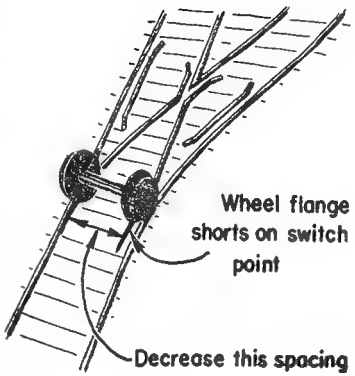
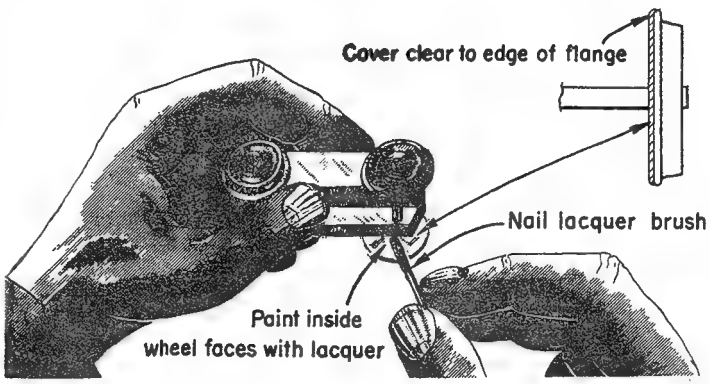




29

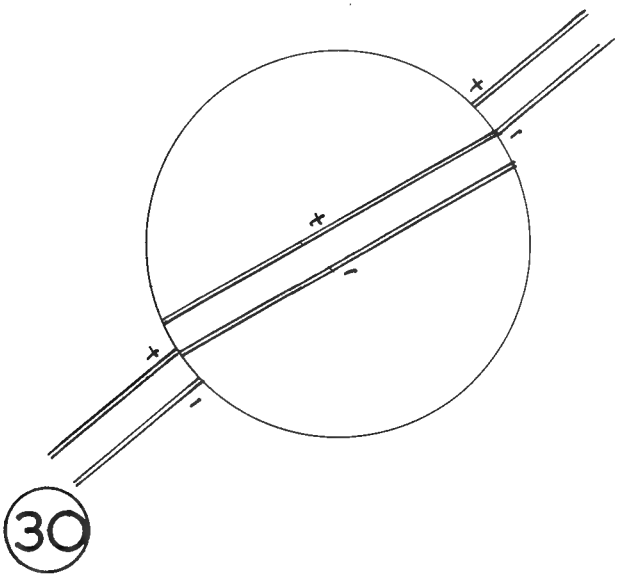
WHEELS FOULING BLADES



the wrong type of tie-rod to a point—it required an insulated rod and I had fitted an integral joint between the blades such as is required by points having an integral frog. (See Fig. 27.) The expanding-rail trouble (through warm weather) is very common. If you will turn to Fig. 28 you will see what is meant. In the instance of a passing loop or a turning loop, if any one rail touches its neighbour at a gap, you will observe that a short will instantly occur, and it can be very elusive unless you are wise to it. It is important, too, to watch the rail-ends at a turntable. These may be touching (Fig. 30) and giving the trouble. Finally, collectors themselves have a way of fouling at times, and need to be borne in mind.

Open Circuits

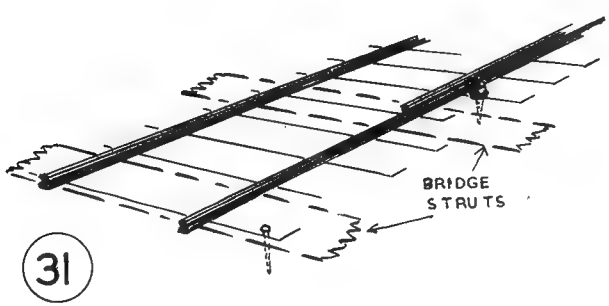
There are other possible troubles apart from short-circuits. These occur when for some reason the supply breaks down. If you use a power unit for your supply, it may be that a plug is not in place, or a wire has worn, or there may, of course, be a defect in the unit itself. It may be simply that a fuse has blown. You may have a defective switch, or a circuit-breaker may be tripped. Some fault may have occurred on your controller or rheostat. A bond at a rail-joint has possibly broken. It

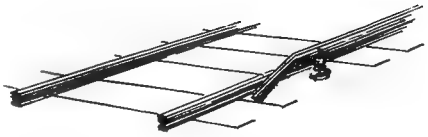


may be simply that your rails or loco collectors are dirty. If your locomotive's action is merely sluggish, then look for some fault or weakness in the motor magnet, collectors may be too heavily sprung against wheels, or brushes may be too loose or too tight on the commutator.

Three-rail Troubles

Some short-circuits take a different form with three-rail power supply. Consult Fig. 31, where a spike has touched a bridge girder, and Fig. 32, where the turned-down end of a conductor rail is touching the end of a metal sleeper, or Fig. 33, where the collector itself is contacting a running rail.





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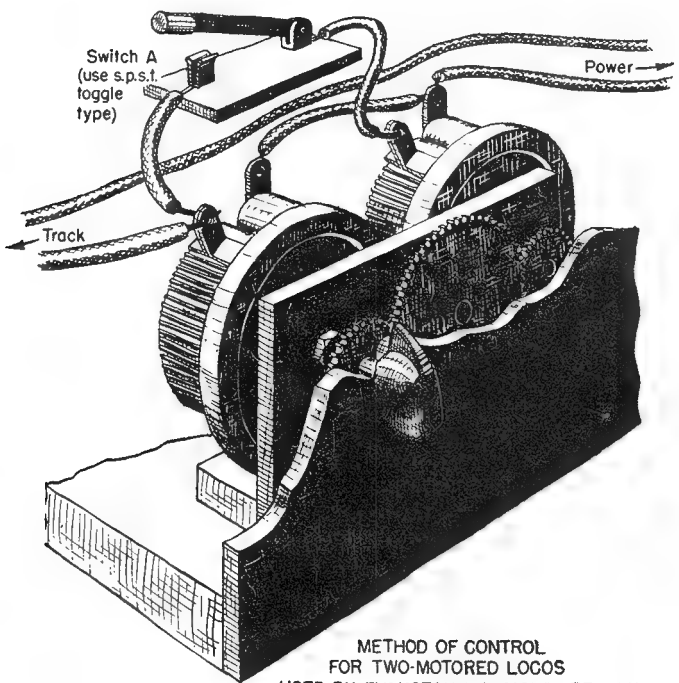
Overloads

One of the most annoying forms of trouble is simply caused by an engine passing from one section to another, the current supply in one section being good and in its neighbour poor. In Fig. 34 I have illustrated this. If your engine's motor is one which takes a big " drink " in starting, then as it passes from the poor section to the full one the motor will possibly take an overload and cut out the circuit-breaker. This amounts to nothing other than a temporary halt, but it should be remedied by tuning up the poor section. You can sometimes get overload trouble with a similar consequence if you are running two engines on one section when the amperage drawn out is greater than the tripping-off capacity

34

35

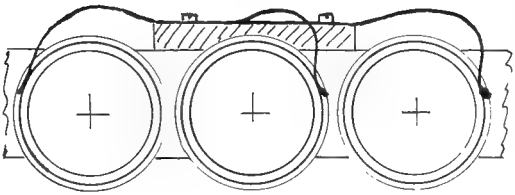
of the cut-out. It is possible to run two engines, as in double-heading, with a restricted amperage figure if the method of doing shown in Fig. 36, as used by a well-known American club, is adopted. Here, there are two controlling rheostats geared together for the purpose, one for each engine.

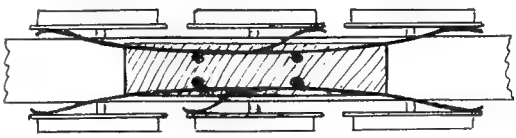


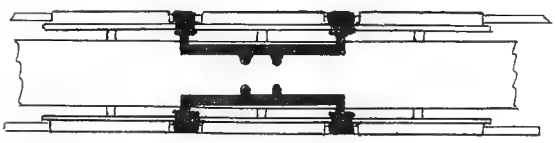
36

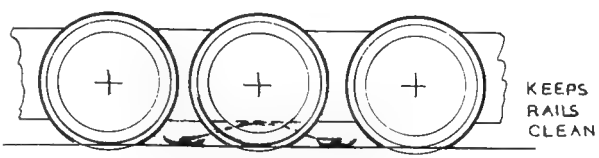
METHOD OF CONTROL
FOR TWO-MOTORED LOCOS
USED BY EVANSTON, ILL. MODEL RR. CLUB

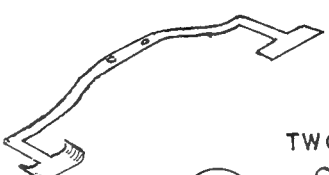
Locomotive collectors are such an important factor in good power-supply that I have given diagrams illustrative of the best types to use. Those for two-rail are shown in Fig. 37, those for three-rail in Fig. 38. Two-rail collectors may be above or below the wheels, or they may operate directly on the surface of the rail, where they are much more reliable if correctly shaped and designed, and where they also serve to keep the rail and wheels clean. The three-rail collector with tubes and springs is, of course, shown upside down.





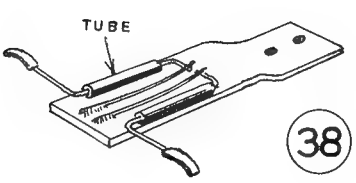






TWO-RAIL
COLLECTORS

37



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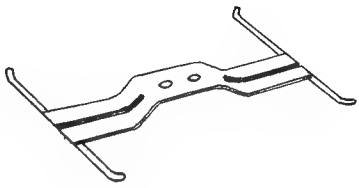
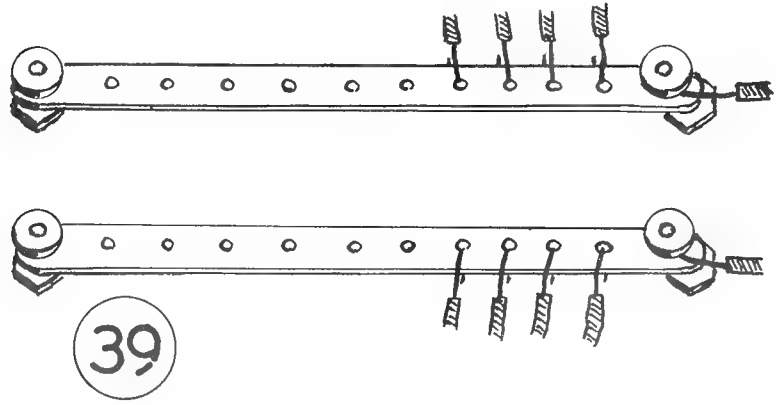


Batteries and Power Sources

The important question as to what form of power source is to be preferred has been discussed in an earlier handbook, but a few words may be added here. The actual supply may, of course, be either from a battery or multiple batteries, or from what is known as a power unit, this consisting of a transformer-rectifier stepping down the power from that of the mains to 12 volts D.C. There is no doubt that of the two the latter is the better. It is less trouble, cheaper and more dependable. The West Midland happens to be supplied, for reasons unavoidable, from batteries, which are tapped off house-lighting batteries in two 14-volt sets for split-potential service. The extra 2 volts are provided in order to cope with voltage drop where the cables have to travel about 50 yards to the railway salon. If it is necessary to have batteries installed under a layout, a good scheme is to build a small battery-cart on the same principle as that described for under-board inspection, providing castors, so that the heavy containers can be wheeled instead of being carried. They will require periodic removal for re-charging. Some suggestions regarding power units may be useful. For oo-Gauge allow $1\frac{1}{2}$ amps for each engine that will be running at a time, for o-Gauge allow $2\frac{1}{2}$ amps. Thus, for three oo-Gauge engines, you will need 5 amps.



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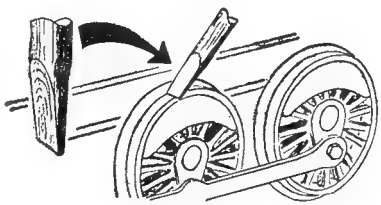
MAINTENANCE

It is important to give constant attention to the cleaning of battery terminals, to re-charging and to topping up with distilled water, seeing that the plates are always covered. It will also be found that as the wiring of a layout proceeds there will be increasing need of additional terminal screws at the main supply source. These terminal-bars can easily be made in the manner shown in Fig. 39, where two lengths of Meccano strip are used to advantage. Finally, if you have at hand a file of old issues of the *Model Railway Constructor*, you will find some good advice about batteries in the one dated May, 1937.



40

A great deal constantly depends on the cleanliness of locomotive wheels. It can only be repeated that if the track is laid on modern principles, a rubberised trackbed being laid beneath it, the wheels will keep themselves clean by constant action. The rubber allows the track to be sunk down as the engines pass over it, so that every wheel is always in contact and is kept polished. Dirt is manufactured only when wheels that are energised pass over track without a firm contact, thus producing deposit. But where dirt does gather, it should be removed by the method shown in Fig. 40, where a sharpened stick is used to clean it off against the driving of the wheels.

LOCOMOTIVE SUPERVISION

Mechanisms

It is surprising how different locomotives have their different moods and tempers even on the same layout and under identical running conditions. It is therefore necessary for the owner to know something about the general make-up of the mechanisms and running gear which become affected.

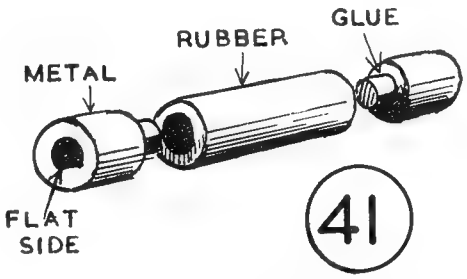
A great proportion of motor trouble arises from badly adjusted armature bearings. One can obtain a new motor from one of the most reputable firms and find that the armature shaft has never been properly adjusted to its bearings or that the bearings have not been tightly packed, if they are of that type. The result is spasmodic and noisy running, the most usual form of noise being a whine. It is possible, with a really good type of motor, so to adjust it that it will run with absolute silence; but this is a task which only long experience can teach. It is well to remember that the slightest amount of binding in the revolving of the armature is going to make a great difference when the motor is giving something like 5,000 revolutions per minute. The bearings must be neither too loose nor too tight; if too loose, the armature will be likely to rub against the pole-pieces, and if too tight there will be overheating. An armature running loosely is sure to be noisy.

The brushes of a motor will often also need inspection. Some quite excellent motors having disc commutators, with flat phosphor bronze brush gear, tend to heat up their brush-arms so that they lose their temper when they have run for a while, and require to be rested and cooled down before they regain efficiency and speed. This seems to reflect upon the general satisfactoriness of the disc type of commutator and the flat-spring type of brush. Other brush gear, carrying carbon brushes, will require to have their carbons changed as they wear away. This is a quite easy task as a rule, though more difficult if the brush-holder has broken or worn. In this event the simplest course is to keep a few spare brushes for standard types of motor always on hand; they are quite cheap. It should also be remembered that brushes should bear upon the commutator at exactly the correct pressure—not too lightly, not too heavily. If too heavily, then, as with an over-tight bearing, the mechanism will overheat; and if too lightly there will be absence of power and speed. The faces of the carbons should bear on the commutator as a glove on a hand, exactly fitting the shape of the circle and perfectly angled all ways to lie over it.

A further important matter is that of the meshing of the gears, especially where worm-gear is employed, as it is on nearly all modern

locomotive mechanisms. Few people realise that the worm must mesh with its wheel at a perfect angle from six different standpoints, laterally, longitudinally and from the standpoint of height; left and right, high and low, forward and backward. Moreover, a mechanism will definitely not run efficiently unless the exact medium of all these positions is secured.

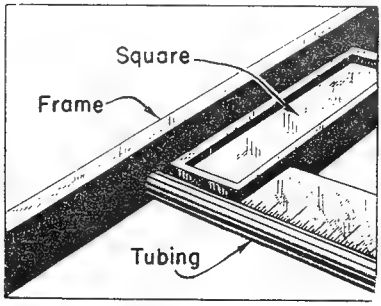
Some mechanisms are geared through a universal joint, and there are very few such appliances that do not cause heavy friction and resultant noise. It is necessary, of course, to employ the universal joint where there is any kind of movement or oscillation required by the mechanism in relation to the motor; and in this event it is essential that the universal joint should be exactly in line with the pivot about which the movement takes place. Of all the forms of universal joint I know, the best on the market seems to be the Mantua (American) type illustrated in Fig. 41. This is absolutely silent, of very low cost and lasts for years.



As regards wheel-insulation for mechanism driving wheels, there are two forms still in standard use in Britain, the rim-insulated type and the hub-insulated. Reidmere mechanisms take the latter form. I believe that current-collection from the wheels is actually rather better with hub-insulation—there is a larger surface on the back of the wheel on which to work. But, otherwise, the rim-insulated wheel would seem to be preferable.

In the oo-Gauge scale, so far as armatures, commutators, brushes and small motor parts are concerned, all the makers of standard designs provide for the sale of separate parts, so that the simplest method is thus to replace parts which become defective.

The accurate alignment of re-fitted bearings is also an important bit of work. For most wheel and axle types these can be cut from $\frac{1}{8}$-in. inside diameter brass tubing. Instead of cutting the small piece to length before soldering it in, solder in a long length that can be easily squared, and can be then cut when the soldering is done, as shown in Fig. 42.



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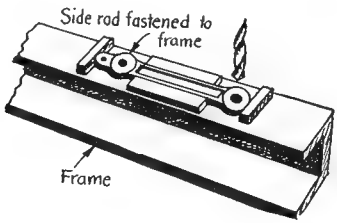
A very useful appliance is a simply made wooden rack, lined with a piece of carpet-felt for the holding of an engine in an inverted position while any work is being done on it. This will both save the superstructure and leave the worker's hands at liberty. The photograph on page — shows one of these racks in use.

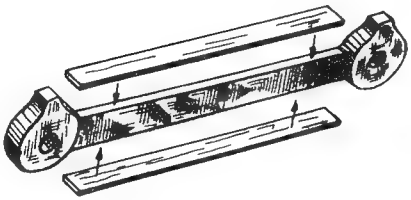
Where bearing apertures have to be actually drilled this can be most readily done in the manner of Fig. 43; the side-rod is soldered lightly, or in some other way held to the frame, the holes being drilled through the pivot-holes of the rods right through the frames. Such work as this will rarely occur as a maintenance item; and if it does it is usually the better course to have actual chassis work executed by one of the many firms which gladly carry it out.



43

It will be found that one of the worst places for the accumulating of dirt on an engine is behind the mechanism wheels. For the purpose of removing this a good instrument is the common pipe-cleaner, which can be passed right down into the cavity and will effectively gather up the dirt.

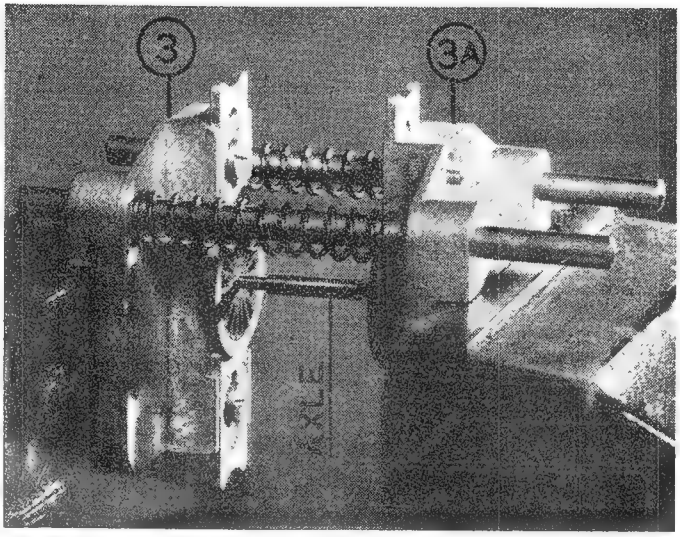
Fluted side-rods are an item which many a locomotive owner will wish to substitute for the somewhat poor rods generally supplied with British mechanisms. In Fig. 44 an idea is given for this work which requires no comment. The flange-pieces are soldered to the rod and afterwards rubbed down on a file to the exact amount of projection desired.



44

Reverting back to the subject of noisy motors, there is no doubt that this fault, where it occurs, constitutes a serious defect. Any sort of electrical whine is out of place on a steam-outlined engine, and as motors can perfectly well be designed and built to avoid such noises, the defect is hardly tolerable. There is still a wide field of improvement ahead for the manufactured British mechanism, and this absence of noise is one of the essential objects to be aimed at. An uneven air-gap in the armature tunnel, a loose-fitting shaft, a projecting set-screw rather than a flush one on a gear, a hollow engine carcass or badly meshed gears can all lead to the noise trouble. An empty firebox might well be lined with thin rubber or cork to absorb the vibration, while the engine itself, despite all arguments to the contrary, should be as heavily filled with lead ballast as is possible.

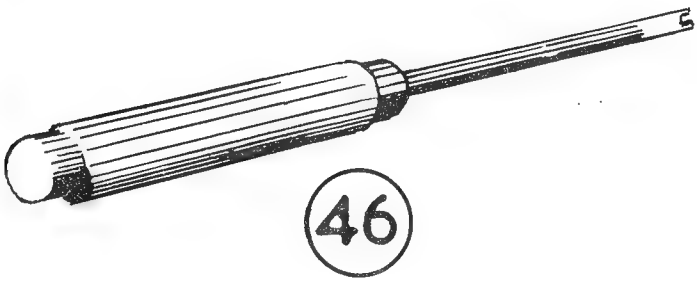
45



MAINTENANCE

Running Gear

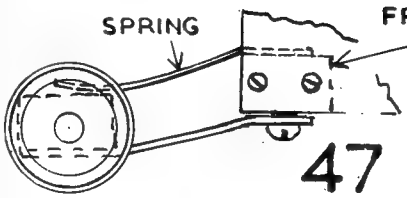
Passing on to the subject of running gear, an important item relating to all locomotive wheels, whether driving, coupled or bogie, is that of exact distancing according to B.R.M.B. standards. Fig. 45 illustrates an excellent appliance produced by A. W. Hambling & Co. for the purpose of fitting wheels on axles, and where Peco insulaxles are employed this machine does the work with the minimum amount of friction against the insulation. It is simply inserted in a small vice as depicted and the wheels screwed home by a twist of the vice. It would be a good scheme, I think, if the manufacturers would supply a wheel-back gauge to fit on axles where there is no shoulder. For the manipulation of set-screws on coupled axle ends, the worker should provide himself with a small screwdriver with a notch filed out as in Fig. 46. This will avoid an enormous amount of trouble.



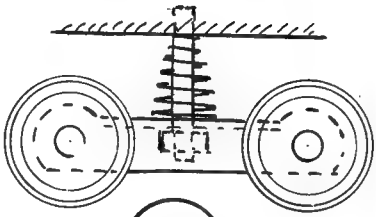
46

It is surprising how easily bogies and pony trucks can be made to keep the track if they are provided with a correctly balanced type of spring, and in Figs. 47 and 48 I have given diagrams showing how this can be done. The best type of spring is a cone-shaped coil one; but failing this I would recommend fine watch-spring such as may be obtained from any jobbing watchmaker.

Valve gear requires careful adjustment when completed, since the slightest disparity or catching of the parts in movement will cause loud noise in working. Should it be desired to make up valve gear from scratch, rather than to use the excellent sets of parts that can be had both in Britain and America, the parts can be made up from german silver or thin brass. An excellent makeshift material can be had from ladies' curling pins. A thickness of about .030-in. is recommended for durability. Draw out the parts on the sheet, drill the holes and finally cut and file up the parts. Lill pins can be used for rivets, being soldered with the intervention of a piece of paper to avoid seizing the parts, the unrequired length of the pin being cut off after soldering. Very good minute hollow rivets can be had in America from Mantua and other firms.

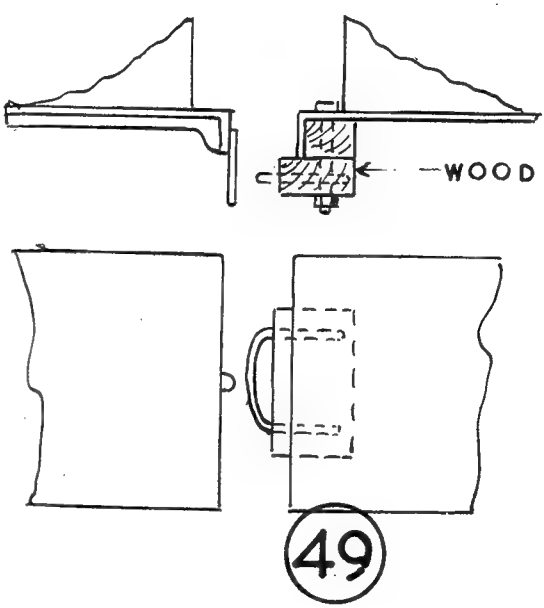


47



48

Where the wheels on one side of the engine and those on the other side of the tender are used for pick-up purposes, it is necessary to insulate the coupling between tender and engine. It is sometimes expedient to do this rather than to dismantle the tender if a short-circuit occurs on one end of a tender axle. I have a locomotive running on the West Midland on which this was done. A simple form of insulated coupling is shown in Fig. 49.



49

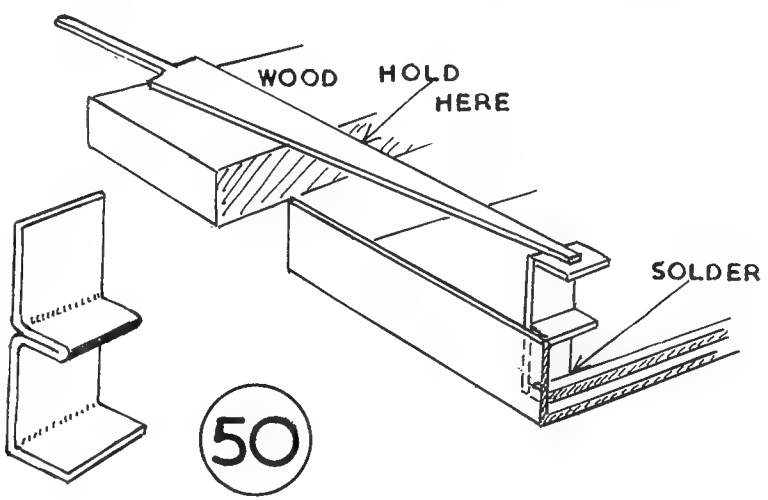
MAINTENANCE

Repairing Locomotive Superstructures

For a vast number of minor repairs and alterations to locomotive bodies it is not necessary to own a fully equipped machine shop. I know of one firm producing excellent scale locomotives complete that does not even own a lathe. Cylinders, boiler, cab, smokeboxes, bogies and trucks, tenders and all accessories can be built with a very modest tool equipment. It is a fairly straightforward business for a machinist to build a locomotive with a perfectly fitted workshop; but it is a matter of clever strategy and improvisation for an amateur to build one in his own way and according to his own equipment.

A good method for cutting sheet metal, which will be one of the first requirements in loco work, is to clamp a piece of wood on the back of the sheet. The wood should be slightly wider than the metal so that the saw will start to cut the wood first. Put the clamps close to the cutting line and the metal will not be torn by the saw. In order to cut out definite shapes, the drawing can be made on tracing paper and stuck on the metal with rubber solution, the paper being removed after the cutting is done.

Many locomotive bodies are in these days die-castings in metal which has a reputation for its non-soldering qualities (zamak and other alloys). Normally this is true unless you can find the correct flux for the purpose. But it will sometimes be possible if you heat the metal to the point that the solder will " puddle " when applied, quickly to scrub it into the alloy with a piece of steel wool. This will tin the surface before oxidisation takes place, and it is easy to continue the soldering after that.

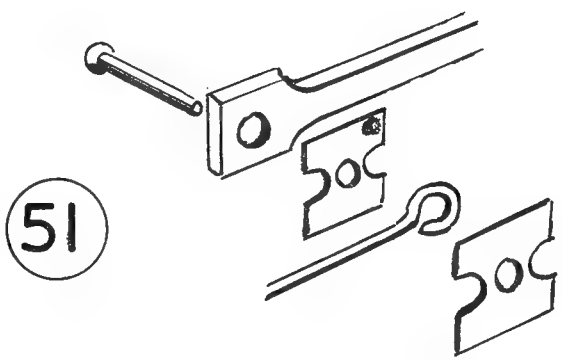


There is also on sale in this country a solution called " Oxybar," made by Clough Ltd., Grenaby Avenue, Croydon, which will add a tinning coat to these metals. Heat the casting, rub on the " Oxybar," then wipe with a clean rag.

A good tip for the soldering of a very small nut over a hole is to hold the nut in place with a stick which should, of course, pass through both nut and hole. This will keep the thread clean and at the same time hold the nut where it is wanted.

Locomotive steps have a way of coming loose in service or on the workbench. Fig. 50 shows what I consider to be the best form of step from the standpoint of soldering, and the best method I know of holding a step while it is being soldered.

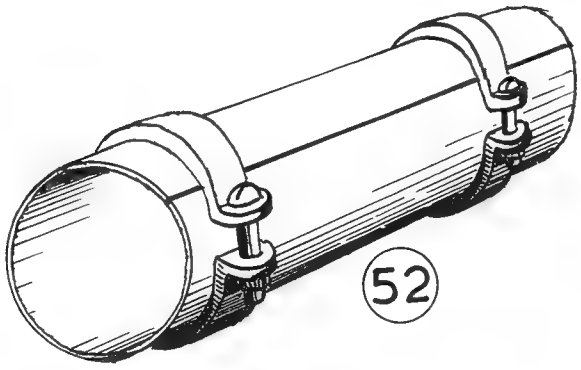
Crossheads will often need to be replaced or to have good ones substituted for dummies or defectives. Crossheads are not difficult to make even from the simplest parts, as Fig. 51 will demonstrate.



Fine wire often comes in coils which require straightening. This can be done by holding one end of the length in a vice and the other in pliers while running a rounded tool like a bradawl along the curved side. If the material is rectangular in section, and twisted, turn it in the direction opposite to the twist while running the tool along. Sheet metal can often be flattened by placing it convex side up on a soft board and rolling it with a piece of iron or steel pipe, the larger the diameter the better. The pipe must be at least as long as the width of the sheet. Small sheets can be hammered without leaving hammer marks by laying them on a small anvil and beating through a thin piece of plywood. A good substitute for an anvil, by the way, is a discarded railway chair of prototype size. Never beat directly with a hammer.

In forming a boiler from sheet metal, a good method of holding the metal to the circular shape required is to clamp it with several

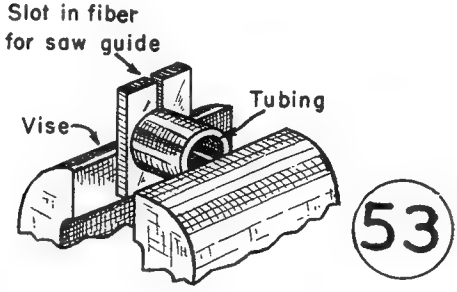
motor-car radiator hose clips. This idea is given in Fig. 52. When the desired tension brings the edges together, solder them and remove the clamps.

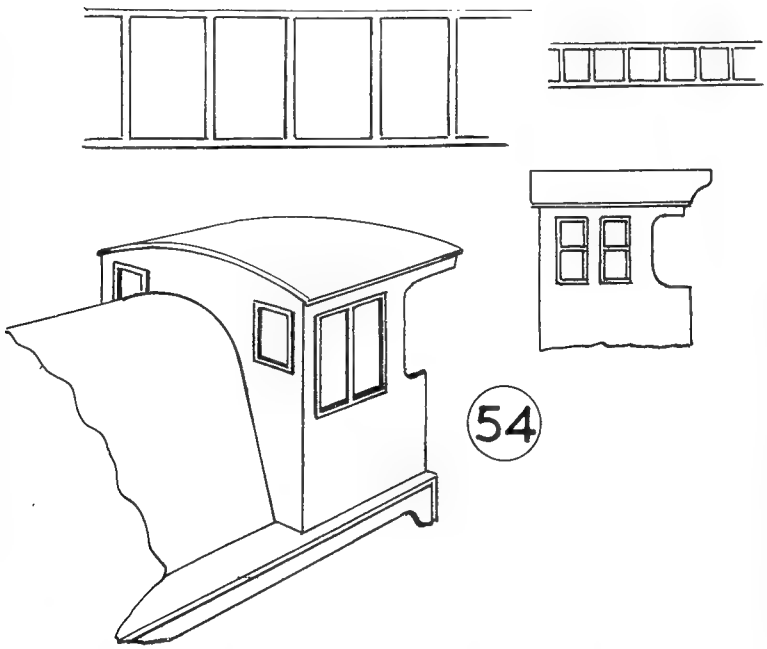


Loy Metal Paste is an excellent medium for the filling up of holes in a die-cast body. It does not require heating, and can be drilled or filed as desired. It is obtainable, with its necessary solvent, from most large garages. I have used this repeatedly for filling up cavities in what were formerly clockwork tank engines, where there is a large hole for the insertion of the winding key.

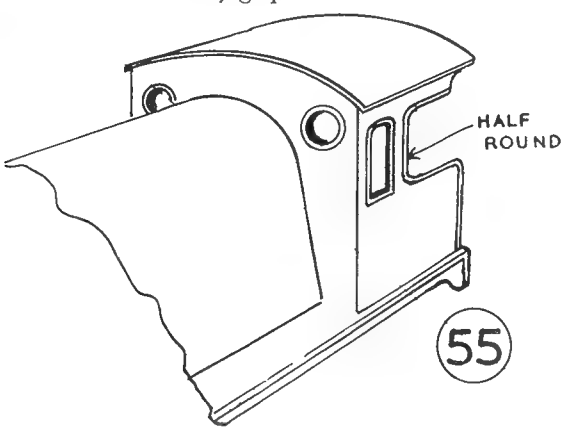
When requiring to drill a hole in metal and finding yourself without the correct drill, use a smaller one, then with a rat-tailed file ream out the hole. But be careful to operate the reamer in an anti-clockwise direction, or it will bite too deeply into the metal and destroy the hole's shape.

In cutting metal tubing, lengthwise, insert it in the vice with a piece of fibre or wood projecting above it as in Fig. 53. Locate the place where the slot is to be cut, then cut into the fibre or wood and down into the tube. This will effectively guide the saw.





It is not generally known that for certain shapes of cab windows an excellent expedient can be had by using small pieces of metal ladder, as in Fig. 54. American o-Gauge ladder is particularly adapted to this purpose if the windows are large, or British signal ladder of oo-Gauge size will sometimes serve for smaller window frames. Another very good scheme is to form the rims of circular windows by using very small shoe-eyes from which the vulcanite surface has been scraped. For windows of special shape, a good material in the absence of half-round wire can be had from ladies' " Kirby-grips."



MAINTENANCE

Painting

The re-painting of locomotives is a maintenance job which varies in its requirements largely according to the skill of the worker and the colour required. Where the need arises for standard railway pigments other than black, with special linings and blendings of tints, it is just as well for the unit to be sent away to be handled by an expert, the cost not being excessive. But for a uniform of black, which in my view is as economical and effective as any for freelance work, there is no difficulty. For this purpose I repeat my recommendation of the dull-drying paint known as " Art Metal Black " which can be had from any of the larger paint shops. It dries quickly, spreads evenly on a clean surface, and has the exact semi-matt finish. It is well to remove the body from the mechanism and to clean it thoroughly by boiling it in soap and water after the old paint is removed. Use a camel-hair brush, kept for no other purpose, of about $\frac{1}{2}$-in. wide and flat. Apply the paint, after thoroughly mixing and shaking it, starting at the edges and seeing that it covers. In painting small parts that are detachable, these can sometimes be inserted into a cork in order to hold them. All locomotive colours should be matt-finishing, being later varnished if it is demanded. My own experience is that brush-work on engines is superior to spraying, if properly done.

It is sometimes convenient to hold a locomotive while painting it by placing it on a short length of track, fixed to a track-board, and slipping elastic rings over the buffers to keep it in place.

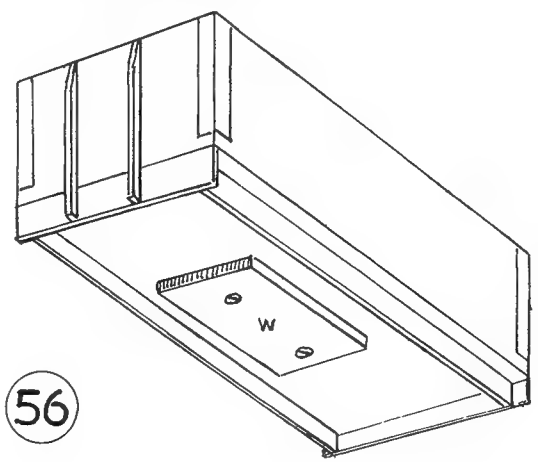
Lining is a work demanding skill. A rather clever expedient for lining on a plain surface like that of a tender-side or tank-sides where the body is built of brass, is by scratching off the surface painting with a sharp instrument and leaving a " gold " line, though this demands a little practice to be done with success.

THE RUNNING STOCK

Good Running

The reduction of noise in operating trains on a model layout is not only a matter relating to locomotives, but also to rolling stock in general, to track construction and to the question of the underbase. Some years ago there appeared a most analytical and painstaking article in the *Model Railroader* from the pen of Mr. Edward Ravenscroft discussing the entire subject, and the author went into great detail in explaining the results of his experiments with various forms of track and general construction. And there is no doubt that with the old method of laying track rigidly on a baseboard innumerable factors do enter into this question. There are the different brands of commercial track, with their respective forms of roadbed, whether wood or cork or cardboard; there is the matter of what kind of ballast is used, if any at all; and even the kind of glue employed will have an effect. But all these items may be completely relegated if a rubber trackbed is used and the track laid loosely as already advocated. Even a card-table felt in place of rubber will almost eliminate track noise, which is the most active source of commotion.

But track is not the only consideration. Certain noises will be thrown off by unsatisfactory rolling stock, especially by wagons that are not heavy enough. It is not generally known that to some extent all small-scale wooden rolling stock should be to some extent weighted, and in Fig. 56 I have given a suggestion as to how this may be done. All



wagons with springs require definite weighting in order that the journals rest up against the tension of the springs, so that the springs act in a negative manner instead of a positive. Otherwise sprung stock will derail more readily than stock that is unsprung.

Derailments, of course, are another trouble where rolling stock is defective. I make that statement guardedly, because rolling stock simply will not derail if rightly constructed. Never believe the people who say that in 00-Gauge good running is impossible. If they have "never seen 00-Gauge trains doing their job," well, I certainly have. I have seen three or four 90-120 wagon trains running at the same time for four or five hours without pause on the layout of Mr. Fleetwood Shawe, and without a single hitch or derailment occurring from start to finish. I have known 00-Gauge locomotives that have run hundreds of actual miles at various exhibitions without a breakdown or failure. And the most important factor in the avoidance of derailment is that the wagon undergear must be absolutely correct in alignment and axle-freedom. There must be practically no side-play whatever on any of the four wheels, though these must be loose enough to avoid any side-friction. The wheels must be perfectly level with each other when the vehicle is standing on a sheet of plate glass. Commercial chassis are by no means always in running order when sent out by their makers, and require to be put through the test and adjusted as necessary. Coach bogies are another item. There are very few types on the market that will give completely good service on the average track, though many types can be so adjusted and fitted as to do so. A bogie should not be pivoted so tightly as to provide resistance on curves, but neither should it be so loose as to allow throw and loose swinging on the part of the body. These factors are more or less a matter of knack and practice.

Track, again, must be constantly kept under survey in order that good running may ensue. Rail joints do not stay put for ever, and have a way of becoming uneven. A little judicious packing and depressing is all that is required. Frogs get knocked out of alignment by the passing of trains more often in one direction than the other. A slight twist with a small screwdriver will almost always put that right. Sometimes the trouble is so slight that it can only be felt and not seen. Run your finger along the inner edge of the rails and over the top of the frog and you will find the defect.

Beware also of tight couplers and locking buffers. If your wagon wheels are relieved of superfluous side-play, squarely set by the axles, and standing four-square, your couplings of standard length and your buffers all spaced uniformly, you will never have such a thing as buffer-locking even though there are no bars across your buffers. So, therefore, if you really want perfect running on the part of your goods stock, why not make it one of your tasks to go completely over every vehicle, making the necessary adjustments?

The question of weight, already touched upon, can scarcely be overstressed. Locomotives should be so filled with lead shot in every

available cavity, the shot if necessary being held in place with Loy metal, that the utmost possible weight is secured; and if there is any exception to this ruling it is in one type of engine only, the fast passenger unit, though there is little danger of error even here. As regards the weight of rolling stock, you can gauge this quite accurately if you so wish, though I am not so sure that you can bring your vehicles up to requirements when you have worked out your figures, or that the weight of a model wagon requires to be in strict proportion to prototype weight. It may be worth finding out, and here is a table for doing so:

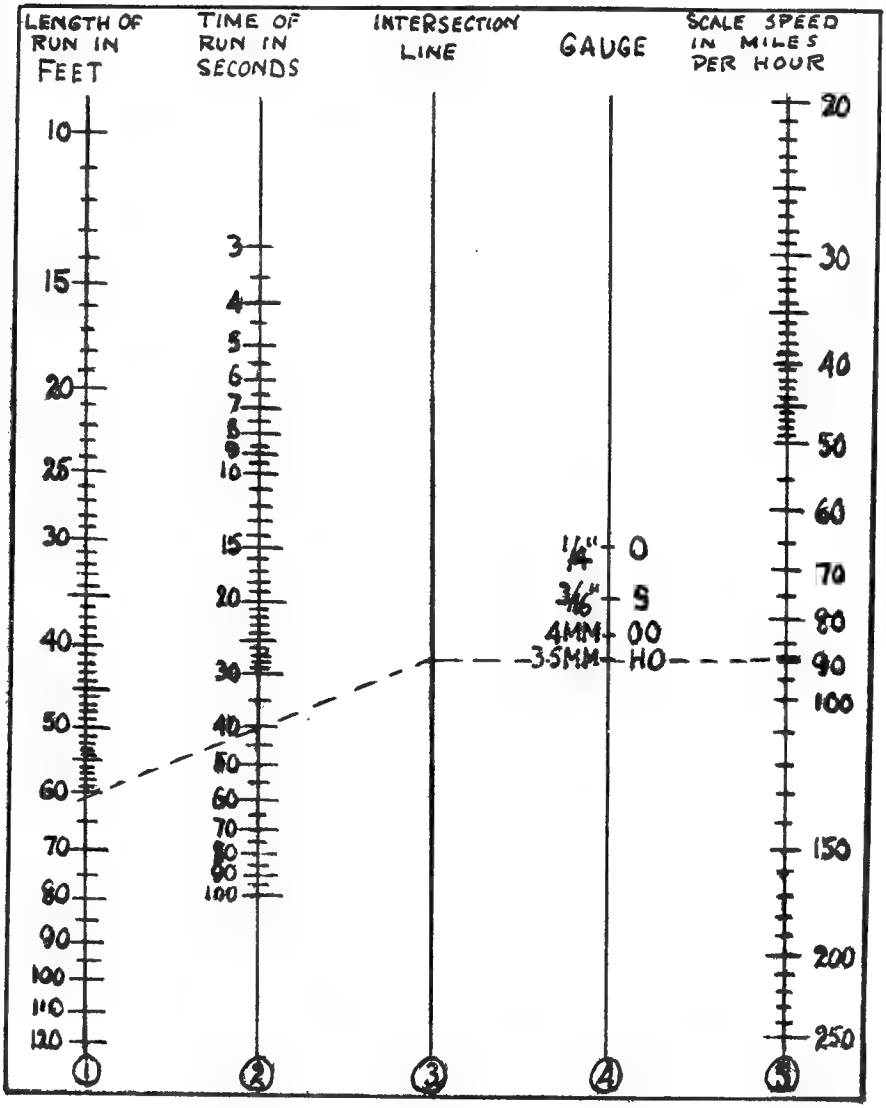
Gauge	Scale Tons per ounce	Scale Tons per pound
0	3·5	55·3
00	13·8	221·2
Ho	20·6	330·4
TT	54·0	864·0
000	93·3	1493·0

These results are obtained by multiplying the actual weight of the model by the scale coefficient, or by dividing the prototype weight in the same way. The coefficients are for 0-Gauge 48, for 00-Gauge 64, for Ho-Gauge 76·05. It should be borne in mind in weighting an engine that the weight is required mainly over the coupled wheels, and so far in other parts of the superstructure as to ensure that there is no " weight-tip " at back or front, or any such tendency. The tender does not require extra weight beyond the amount needed to give it a steady holding on the track. A rail-car only requires weight at the motor end and in the centre, not over the trailing bogie.

One further important matter is that of speed. One of the reasons why Mr. Shawe secures such excellent running results is that he operates all trains at a speed in scale with real practice. And here, with the indulgence of the *Model Railroader* once more, I will give a most useful monograph which appeared recently, by means of which scale speeds can immediately be calculated.

You simply divide the length of run by the time taken, and multiply the result by the gauge coefficient as already given. If the distance is measured in feet and the time in seconds, the result obtained is in feet per second. To get the speed in miles per hour you multiply by 0·682. Thus, suppose a main line run is 60-ft. and the time taken is 40 seconds, then to find the scale speed draw a line through 60 on scale 1 and 40 on scale 2 and continue to intersect line 3; then draw a line from this point to the mark Ho on scale 4, you will find that the line passes through 89 on scale 5, giving 89 m.p.h. You can employ the table repeatedly by using a ruler in place of drawing a line.

Having thus found what scale speed is—and it will probably surprise you—keep your goods trains at about 45 m.p.h. maximum and your passenger expresses at 60-70 m.p.h. You will have far less derailment trouble.


LENGTH OF RUN IN FEET
TIME OF RUN IN SECONDS
INTERSECTION LINE
GAUGE
SCALE SPEED IN MILES PER HOUR
10
15
20
25
30
40
50
60
70
80
90
100
110
120
3
4
5
6
7
8
9
10
15
20
30
40
50
60
70
80
90
100
1/4" O
3/16" S
4MM 00
3.5MM HO
20
30
40
50
60
70
80
90
100
150
200
250
1
2
3
4
5

MAINTENANCE

There are now several commercial couplers on the market, all of which are reasonably efficient, though all have certain slight or serious faults. The Peco is excellent in results, though somewhat heavy in appearance; the H. & N. magnetic type is less conspicuous but not quite so reliable; the Acros, which in my opinion is the best so far, is unfortunately somewhat slight in construction. If it is used in the manner intended, at correct speed and with perfectly set wheels and uniformly spaced buffers, there will be no derailments and consequently no breakages. But this is asking rather a lot of the average layout. But, whatever type of coupling is used, it should be the practice to keep an accurate gauge for setting the heights and distances precisely alike on all vehicles. With the Acro type, no link is required on engines, a correct hook being all that is needed, one at each end. There can be little doubt that the magnetic scheme of uncoupling has come to stay. If the magnet is powerful enough to operate from below the baseboard—which many magnets are—it can be entirely invisible. Its position can be marked by a green-headed toilet pin. Coaches can be permanently coupled in train-sets if so desired.

Rolling Stock Maintenance

There is little to be said in this connection, for wagons and coaches have a way of giving very long and consistent service. Beyond a little wheel-cleaning and lubrication, or perhaps some adjustment to wheels or bogies, there is little to be done. Here is a good tip for those who use Kennedy bogies on passenger or other stock. These bogies usually have a screw, two spring plates and a washer, and it is a little troublesome to slip them on and off—especially to put them on after removal. My own method is to shave a match-stick to a chisel shape at one end. I then take the bogie and screw, insert the latter and slip the match between its head and the cross-bars of the bogie. That holds the screw where I want it. I then add the spring plates and the washer, insert the screw in the bolster hole, turn the vehicle on its back and gently withdraw the match. It now merely remains to drive home the screw.

It is sometimes desired to age the appearance of goods stock, for a whole train of new wagons is somewhat unrealistic. The best method I know is to take a little common soot or lamp-black powder on a wad of cotton-wool and treat the wagon as desired. Passenger coaches of the metal kind, such as are produced by Exley, can be made to look quite resplendent if they are periodically gently sponged with cotton-wool dipped in soap and water, then squeezed almost dry, and afterwards sharply polished with a clean wad of wool. A touch of furniture cream on the wool will work wonders, but it must not get into the window frames.

Lubrication

Under this heading we have one of the most important of all matters pertaining to maintenance. Locomotives, rolling stock, points and signals, and even some types of couplings, must periodically be

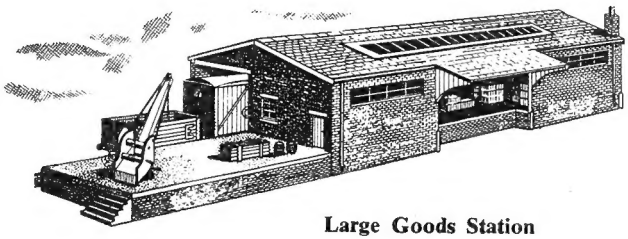
RACK FOR LOCOMOTIVE REPAIRS

carefully oiled, and the oiling must be done so meticulously as not to cause flooding or clogging. Before oil is applied, all dirt resulting from former oilings or from running must be removed. It is surprising what the wheels of a coach or engine will pick up on the cleanest track. I have even found sparrows' feathers so tightly twisted around a coach axle as to take almost half an hour in removal. Watch, then, for these things before starting to oil.

There are also right and wrong oils for the different purposes. I find that " 3 in 1 " is very popular, but a word of warning needs to be given as to the use of it. My experience of it is that it will carry electric current, and that, owing to its cleansing qualities, it seems slightly abrasive. It no doubt has its uses on certain appliances, but keep it off locomotives and Peco insulaxles. The best light oil is probably the newly advertised Duboil, though watch-oil is always reliable for light work. A slightly heavier lubricant may be used on worm drives. The points to oil on a locomotive are the motor bearings (even though they may be of the so-termed oilless type), the wheel bearings, the bogie pins or slots, and the gears. A most ideal oiling instrument is the Dermic Oiler, produced by S. & B. Productions Co.

Not only running stock, but points and other moving appliances must be oiled regularly. In a word, anything on the layout that produces the slightest movement will corrode and dry up so as to be ineffective unless thus attended to.

Lineside Kits



Large Goods Station

The " Lineside " range of kits has been introduced to meet the demand for an inexpensive, easy-to-build kit of parts for railside buildings and features in 4mm. scale.

They are fully comprehensive and contain printed wood and card parts, printed acetate windows, etc., brick and tile papers, plan and full instructions.

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Country Station ...	... 5/6	Water Towers	... 2/9
Large Signal Cabin	... 4/7	Footbridge	... 2/9
Small Signal Cabin	... 3/8	Trackside Features	... 4/7

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